DICTIONARY OF MEDICINE

R. QUAIN, M.D.

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A
DICTIONARY OF MEDICINE

INCLUDING GENERAL PATHOLOGY, GENERAL THERAPEUTICS HYGIENE AND THE DISEASES OF WOMEN AND CHILDREN

BY VARIOUS WRITERS

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struggling for the mastery in the system. The writer's belief is, that in the doubtful cases the real disease is enteric fever, the symptoms being merely modified by malaria, in the same way as they are in many other diseases.

Prognosis.—This is favourable when the remissions are distinct; when each succeeding exacerbation diminishes in force; when the skin acts freely; and when the urine deposits the sediment described as critical in intermittent fever as the attacks pass off.

Faint and uncertain remissions; a tendency to collapse at the close of an exacerbation; the sudden setting in of dangerous complications; the predominance of typhoid symptoms; suppression of urine; and a general disposition to hæmorrhage from the mucous surfaces, are all signs of evil omen.

Treatment.—After a large experience in the treatment of malarial fevers in some of the most unhealthy regions in the East, the writer desires to place on record the fact that he has never seen any but disastrous results from treatment based on the belief that remittent fever is an inflammatory disease. The practitioner who keeps this in view, and acts on the principle of saving power as much as possible, will save more lives than the man who, alarmed by the violent disturbance of the system, attempts to calm it by lowering treatment; or the other, who, halting between two opinions, seeks to cure his patients by an incompatible mixture of depressing and conservative remedies. With the reservations already given when treating of intermittent fever, no better combination of a purgative with quinine can be given, to begin the treatment, than Livingstone's, described in the article on that disease; but whatever be the purgative selected, it should be suited to bring away copious bilious discharges, which will greatly mitigate the vomiting, and it should be combined with quinine. A good formula is one for a five-grain pill consisting of calomel, compound extract of colocynth, and powder of scammony, with a drop or two of any aromatic oil; this acts effectually on the whole tract of the intestine, usually without nausea or griping, and a like quantity of quinine may be added.

Two courses are now open to the practitioner. One is to postpone the further administration of quinine until the first remission. In the other the exacerbation is disregarded, and quinine is given in full and effective doses at once. If the first plan be decided on, much may be done to promote the comfort of the patient, to lower the temperature, and thus to hasten the period of remission. In strong men, when the temperature is high, exceeding 105° F., with headache, violent action of the heart, rapid respiration, oppression, and restlessness, drop doses of the tincture of aconite every quarter of an hour, until ten or twelve doses have been taken, calm the patient, reduce the force of the heart's action, assuage the headache, and sometimes in a marked manner relieve urgent and distressing symptoms. Used in this way, and its effects watched, aconite is a valuable and safe remedy, and, acting in the same way, it is as useful in specific yellow fever. It has also this great recommendation, if cautiously used, that it leaves no sting behind.

When the temperature rises, as it often does, to 105–6° or 110°, more energetic means are called for. The patient should be placed in a bath at 90° F., which should be cooled down until the thermometer indicates a temperature 15° below the normal temperature of his body. The effect of this in calming the patient, relieving the oppression, and checking vomiting, is often very striking. When removed from the bath, the patient should be wrapped in a blanket. In adynamic cases, where the use of the bath is not deemed prudent, the same good effects may be brought about by sponging the surface with water, the temperature of which is gradually reduced as directed above. This, in most cases, is certainly the safest practice.

On the first appearance of the remission, quinine must be given by the mouth, bowel, or skin. If there is no vomiting, by the mouth; if the remedy will not remain on the stomach, then it must be given by bowel or skin. Of the inconveniences and occasional danger of the latter method, the writer has spoken in the article Intermittent Fever, to which the reader is referred.[1] If the hypodermic method is ever justifiable, in the face of the danger of inducing tetanus in the manner described, it is in the grave and pernicious forms of this disease, when life is threatened, and time presses. If the remedy is given by mouth or rectum, in severe cases, not less than half a drachm should be introduced into the system during the remission. It is in remittent fever of the urgent kind under notice that Warburg's tincture already mentioned (*see* Intermittent Fever) is most useful. As is now well known, the active ingredient in this remedy is quinine; and, if used as directed in the article referred to, it is as safe as it is effective.[2] American physicians appear, in treating this disease, to follow chiefly the second plan mentioned, and, trusting to the known property of quinine to diminish and not to increase temperature, they give it during the hot stage. The great difficulty here is the vomiting; during the exacerbation it is almost impossible to get anything to remain on the stomach. It must then be administered by enema to the extent of half a drachm, half the quantity being given in the same way three hours before the return of the exacerbations. Full doses of from twenty to thirty grains of the bromide of potassium should be given with the quinine, to calm restlessness and promote sleep. The above treatment must be persistently followed day by day until the fever is overcome.

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[1] If the hypodermic method is used, the neutral sulphate of quinine is the safest form, in doses of six grains; the utmost care being taken to perfectly sterilise the syringe and needle.

[2] Spurious imitations of this tincture have brought this remedy into disrepute. As used by the writer, it was always obtained direct from Warburg himself.

It will be seen from the above remarks that obstinate vomiting is not only a source of extreme and exhausting distress to the patient, but also one of the chief embarrassments of the practitioner. The means advised above are often effectual in checking it, and they may be supplemented by the use of ice when available, by external stimulants over the stomach, or by the application of cloths sprinkled with chloroform over the same region. Drop doses of Fowler's solution of arsenic have been found by Bellot the younger effective in checking this distressing symptom in yellow fever, and the same remedy may possibly be of use in cases resisting other means. But in the writer's experience vomiting, as a rule, subsides with the other symptoms, when the exacerbations are controlled by quinine. What was said, under the head of intermittent fever, of the danger of pausing in the use of quinine, to treat this or that complication, is most emphatically repeated here.

On the first sign of collapse in any stage, recourse must be had to stimulants; white wine whey is an excellent vehicle for the administration of alcohol, if that be called for; good champagne, if available, or the best Rhenish wine within reach, often answers admirably, and is keenly relished. Livingstone's party used bitter ale, and speak in praise of it as a stimulant grateful to the patient, 'frequently remaining on the stomach when all others are rejected.' The large experience of such intelligent observers on such a subject is worthy of respect. It is hardly necessary to dwell on the necessity of sustaining the patient during the remission by a diet adapted to the irritable condition of the stomach. With one remark—one pregnant remark by the Rev. Horace Waller, the fellow-traveller, friend, and biographer of the illustrious Livingstone—we shall close this article: 'One thing, however, must be strongly urged: it is that all notions about not being able to "stand quinine," that it "flies to the head," and so forth, must be banished as utter nonsense. In Africa everyone can stand quinine; there is scarcely a disorder there in which it is not positively required.' The writer adds from his experience that this is as true of malarial regions in other parts of the world as it is of Africa.

W. C. MACLEAN.

REMOTE CAUSES.—This expression is used as a synonym for predisposing causes. *See* DISEASE, Causes of; and PREDISPOSITION TO DISEASE.

RENAL CALCULUS.—SYNON.: Nephrolithiasis; Fr. *Calcul Rénal*; Ger. *Nierenstein.*

DEFINITION.—A concretion formed by the deposit of one or more of the solid constituents of the urine. It differs only in size from the gritty particles called 'gravel'; it may be single, or there may be many; it may be present in one or both kidneys at the same time; and it occurs at all periods of life, from the fœtus *in utero* up to the extremest old age.

ÆTIOLOGY.—The majority of urinary calculi are primarily formed in the infundibula or uriniferous tubes of the kidney; and are caused by precipitation, in the nascent state, of uric acid or oxalate of calcium. This precipitation may be due to real excess of the insoluble uric acid, to high acidity, to poverty in salines, to low pigmentation, or to deficiency of the water of the urine; but the precise form and proximate cause of the deposit are determined by the presence of a colloid matrix, composed of mucus or blood-globules, or other animal basis (*see* CALCULUS). Increase by gradual accretion goes slowly on until blockage of the duct occurs; the calculus is then either floated by the urinary stream into the pelvis of the kidney and onwards through the ureter, or it becomes impacted in some part of its transit, and develops into a full-formed renal stone, which, minute at first, may grow to enormous proportions.

VARIETIES.—By far the most frequent variety of renal calculus in this country is that composed of uric acid; in the Eastern counties, where stone is most common, it is very rare indeed to find in the adult any other primary form. Even in children, in whom oxalate of calcium is not uncommon, uric acid is the most prevalent. It is thought by some pathologists that oxalate of calcium forms the first starting-point even of uric acid stones, but this statement lacks proof. The sparing solubility of uric acid and of oxalate of calcium is probably the cause of their greater frequency in calculi; but other agents may occasionally be found to constitute the primary nucleus of renal stone, such as cystine, carbonate of calcium, phosphate of calcium, either by itself or in combination with the ammonio-magnesium phosphate, forming what is designated the fusible calculus, and urate of ammonium or the mixed urates. The phosphates and urates, however, are more likely to occur as secondary than as primary deposits. Mixed or alternating calculi are frequently met with, in which are seen alternate strata or layers of uric acid, oxalate of calcium, and phosphates, the latter generally constituting the external part.

Pathological Effects.—The action of a calculus on the structure and condition of the kidney depends much on its size. At first it may produce irritation and local congestion, possibly leading to actual inflammation, and even abscess within or external to the capsule. This may happen when the stone develops in the tubular or secreting structure; but when it remains and enlarges in the pelvis of the kidney, chronic pyelitis is more likely to ensue, with changes of an atrophic character. The pelvis dilates; pressure comes to be slowly exerted on the renal structure, causing wasting, until but little secreting tissue is left; and a large stone remains, occupying the pelvis and branching into the calyces, in shape resembling a cauliflower, and with little covering beyond the capsule of the kidney.

Symptoms.—The genesis of renal concretions is always unrevealed by symptoms; their retention and development up to a considerable size or in great numbers may be unsuspected and unnoticed; and even their transit and escape through the urinary passages may be painless. Usually, however, there is some degree of lumbar pain, generally restricted to the side affected, spreading more or less to the front of the body, and down towards the groin and bladder. The pain is apt to be aggravated by exercise—especially by carriage exercise, and it is liable on such occasions to become very severe; so also when, from any cause, it is disturbed in its bed, or makes a fruitless attempt to enter the ureter (renal colic).

When a stone of some magnitude is passing down the ureter, symptoms of a very acute character usually ensue. The pain rises to intense agony in the loin, and along the course of the ureter down to the bladder and testicle; frequently there is sickness or vomiting; the patient is bathed in perspiration; and he sometimes passes into a state of fainting and collapse. The bladder is frequently irritable; the urine is smoky from the presence of blood, or of elongated clots; or almost pure blood escapes. These symptoms may come on suddenly; may last a few hours or a few days; and may end as suddenly when the calculus reaches the bladder.

The changes produced in the urine by renal calculus may be very slight. Hæmorrhage is the most common and most characteristic; sometimes it is in quantity enough to render the urine smoky or like porter; at other times it can only be detected by the microscope. When it exists in any palpable amount, albumen will, of course, be present too. Pus, mucus, and epithelium will show themselves when the calculus has produced some degree of pyelitis. In long-standing cases a tumour may be felt in the situation of the kidney. The patient resting on his back, and the knees being drawn up, the practitioner with one hand behind presses the kidney forwards, and with the other in front presses it backwards below the margin of the ribs. He may thus, in young and thin persons—aided, perhaps, by the administration of ether—differentiate a renal stone from any of the usual kinds of renal tumours.

Diagnosis.—Renal calculus may be mistaken for various diseases: (1) Bilious attacks, intestinal colic, or perityphlitis. The sickness and pain in the flank are present in all, but in nephritic colic the pain is apt to be more located in the loin, although this is by no means always so. The presence of hæmaturia will be conclusive. In typhlitis and perityphlitis there will be fever and local tenderness. (2) Obscure pain in the back, due to chronic lumbago or neuralgia. In these conditions the pain is generally across the back, and not unilateral; it is aggravated by movements of the affected muscles; and there is no hæmaturia or other urinary complication. (3) Cancer or other renal tumour. Pain and hæmaturia are characteristic of both stone and cancer, but in calculus the health is generally good, while in cancer it is always deteriorated. In stone there is seldom any tumour, and when it does exist it must be of limited size, and hard, whereas in cancer it is diffused, and may be soft.

Prognosis.—The frequent formation and escape of renal stones may continue for a great many years without any material injury to the general health. Even when blockage of the ureter takes place, leading to hydronephrosis and atrophy of the organ, or to nephritis or perinephritis with abscess, a fair measure of health may be preserved, provided the other kidney is in a healthy condition. When both organs are affected, or when complications arise, such as amyloid or tubercular disease, or chronic pyelitis, then the health steadily deteriorates, emaciation proceeds, with hectic and fatal exhaustion.

Treatment.—Bearing in mind that the large majority of renal stones are composed of uric acid, and that it is not difficult to form a correct diagnosis on this point, it will be necessary chiefly to consider the treatment of this form of concretion. Preventive treatment consists in a rigid limitation as to the *quantity* of food taken. It is customary to condemn a free use of animal food and highly seasoned dishes; but it should be borne in mind that stone prevails largely amongst the poor, who seldom can indulge in animal food to excess, and it is not infrequent in countries where no animal food is taken. Far more important is it, both as to food and drink, to observe a strict moderation as to the amount taken. In this way digestion and assimilation will be easy and perfect; crude matters will not find their way into the blood; the chemical conversion of uric acid will be complete; and precipitation in the uriniferous tubes will be obviated. When the proclivity to uric acid calculi is decided, or when a small stone is known to exist, the free use of diluents and alkaline remedies is undoubtedly of importance. The waters of Vichy, Ems, Contrexéville, and Neuenahr, taken freely at the springs, with or without baths, but with the great aid of change of air and mode of life, constitute the most efficient plan of treatment; but it must be admitted that in the majority of cases this good effect is only transient. Some high authorities recommend, in preference to the simple alkaline treatment, the use of those saline aperient waters the chief ingredient of which is sulphate of sodium, such as Carlsbad and Friedrichshall; and undoubtedly they have a most beneficial action, by promoting digestion and assimilation. But as with the alkaline remedies, whether natural waters or drugs, so with the salines, their action is evanescent. Leave them off, and let the patient return, perhaps to a place where calculus is frequent, or to habits of careless living, or to over-work, and the morbid tendency will almost certainly recur. If there are clear indications of the actual presence of a renal stone, composed of uric acid, of moderate size and recent date, the solvent treatment, as described by Sir William Roberts, should be fully carried out. It depends for its success on the known solubility of uric acid and its salts in alkaline solutions of definite strength, the most efficient being about sixty grains to the pint; above and below this strength the solvent power diminishes. The patient, if an adult, should take forty to fifty grains of the acetate or citrate of potassium in three or four ounces of water every three hours during the day, and once at least in the night; this plan should be continued for two or three months. During the treatment the urine should be frequently examined, and if any approach to an ammoniacal state should appear, the treatment must be suspended for a time. The effect of the treatment must be estimated by the diminution of lumbar pain, and by the escape of small calculi; no ill-effects are caused; seldom any indigestion; and no impairment of general health. Other drugs have been employed for the solution of uric acid, such as carbonate of lithium, phosphate of sodium, tartrates and carbonates of potassium and sodium, also carbonate of calcium and piperazin. Some years ago the writer conducted some experiments with prepared chalk, and found that when given to the extent of twenty to thirty grains in mucilage and mint water, three or four times a day, it had a most marked effect in quickly removing uric acid deposits, and it will have this effect even in the febrile state. It did not, in the quantities given, produce alkalinity of the urine, but it acted distinctly as a diuretic.

In the crisis of nephritic colic, narcotics are called for, in doses large enough and frequent enough to control the pain. If sickness is troublesome, morphine may be administered subcutaneously; or, if there be vesical irritation, by suppository. If the agony be extreme and in paroxysms, chloroform may be inhaled occasionally; while the hot bath, anodyne fomentations, and stupes are useful aids to relieve and soothe.

Surgical treatment of renal stone has of late years come prominently into notice. Incision in the lumbar region and removal of a stone is as old as Hippocrates, but nephrolithotomy and nephrectomy have taken their place amongst recognised surgical operations only within the last decade. For the conditions which justify and call for these operations, and for the steps to be taken in their execution, the records of surgery must be consulted. WILLIAM CADGE.

RENAL COLIC.—SYNON.: *Nephralgia Calculosa*; Fr. *Colique Néphrétique*; Ger. *Nierenkolik.*—The name commonly applied to the symptoms which arise when a renal calculus either passes, or attempts to pass, down the ureter. *See* RENAL CALCULUS.

RENAL DISEASES.—*See* KIDNEYS, Diseases of.

RENNES-LES-BAINS, in France (Aude). — Muriated alkaline and earthy sulphatic waters. *See* MINERAL WATERS.

RESISTANCE.—The sensation recognised by the fingers of the degree to which a part yields or resists when palpation or percussion is being performed. *See* PHYSICAL EXAMINATION.

RESOLUTION (*resolvo*, I loose).—The return of a diseased part to its natural condition; chiefly applied to the process of inflammation when it subsides gradually, and without the occurrence of suppuration or other unfavourable termination. *See* INFLAMMATION.

RESOLVENTS (*resolvo*, I loose).—Anything which aids the absorption of effused products may be included in this class of remedies; the most efficient being, externally, counter-irritation and poultices; and internally, mercury and iodide of potassium. Our knowledge of the precise mode of their action is still very vague. The subject of blisters and the like is considered under COUNTER-IRRITATION. It is generally held that mercury renders fibrin less cohesive; and that iodide of potassium—in virtue, probably, of the free iodine which is separated within the blood—has a special affinity for albuminous bodies, and for that form of lowly organised tissue which is so commonly produced in the tissues during the more advanced stages of constitutional syphilis. It is difficult, however, to discuss this therapeutical heading from a strictly scientific standpoint, deriving its origin as it does from a past epoch, when pathological science was still in its infancy, and when very active modes of treatment were held to possess virtues which further experience has not confirmed. Free bleeding and blistering, combined with copious salivation, were held in those days to have a most powerful influence in checking inflammation, and removing its products; and we are only now learning to assign to unaided nature the due share which she takes in effecting what we are accustomed to call the 'cure' of disease.

R. Farquharson.

RESONANCE (*resono*, I sound again, echo).—Resonance signifies the character of the sound yielded on percussion over the greater part of the chest, and, within wide limits, of the abdomen also. The degree of resonance depends principally upon the proportion of air contained in the underlying cavities or organs. *Vocal resonance* is the voice-sound transmitted through the chest to the ear of the auscultator. It is increased or diminished in accordance with the physical conditions present in the chest-cavity.

Hyper-resonance is a term used to signify undue resonance over a given part.

Deficient resonance is commonly called *dulness.* Like *hyper-resonance*, it is often used in a relative sense, in comparing the percussion-note of different parts of the chest or abdomen. *See* Physical Examination.

R. Douglas Powell.

RESPIRATION, Disorders of.—A due performance of the function of respiration is essential to the well-being of the economy, and any derangement of this function is likely to be followed by more or less disturbance of the entire system, varying in degree and gravity, but often of a serious character. Moreover, the phenomena resulting from such a derangement are commonly of much significance in relation to diagnosis, prognosis, and treatment. Therefore, disorders affecting breathing demand attentive and careful observation and consideration in every case; while their general study by no means receives the thought and attention which its importance emphatically requires. In a short article it will be impossible to do more than give a very condensed summary of the subject. The several forms of disordered breathing associated with particular diseases are indicated in their appropriate articles.

Before considering the disorders of respiration, it will be well to call to mind the following points relating to the performance of the act in health. The average frequency of breathing is from sixteen to twenty per minute in adults, although this rate is easily disturbed temporarily by various physiological conditions. The function is powerfully under the influence of the nervous system, and is ordinarily carried on either by centric or reflex stimulation, without any conscious voluntary effort on the part of the individual. In ordinary respiration scarcely any movement or other sign of the act is observable to an onlooker, and the actual quantity of air changed with each breath is very small, amounting only to from sixteen to twenty cubic inches; but in this respect also the act is very liable to be disturbed, while a person is able voluntarily, without any difficulty, to breathe more or less deeply, performing 'extraordinary respiration,' and he may thus change large quantities of air, and call into play every part of his lungs. Remembering what respiration is intended for, the conditions required for its proper performance in connexion with the breathing-apparatus are, that there should be a sufficient supply of air suitable for the purpose, and an adequate passage for its entrance and exit; that there should be enough healthy lung-tissue; that the blood should pass freely through the lungs, and be within certain limits of a proper quality; that there should be no mechanical impediment to the free play of the lungs, especially if suddenly called upon to do extra work; and that the forces by which the respiratory movements are carried on, namely, the muscles, including the diaphragm, and the elasticity of the lungs and chest-walls, are equal to their requirements. If the act of breathing is systematically watched, it will be found that normally expiration is rather longer than inspiration; but there is no striking difference between the two divisions, the ratio being as twelve to ten in males, fourteen to ten in females. Moreover, the movements are both thoracic and abdominal, the former being distinctly made up of expansion and elevation during inspiration, of retraction and depression during expiration, especially when a full breath is taken. The intercostal spaces in most parts, as well as the supra-clavicular fossæ, seem to sink in during inspiration, so as to become more evident, this being more marked in proportion to the depth of the inspiration. It will further be noticed that the precise movements differ in different persons, and according to the extent of respiration. The lower ribs and diaphragm act principally in males and children during ordinary breathing; in adult females the respiration is upper costal. In extraordinary breathing the movements are chiefly upper thoracic in all persons.

Respiration is markedly influenced by physiological conditions, such as exercise, diet, sleep, and various other causes; these must be remembered and duly allowed for in considering its derangements.

With these introductory remarks, the

disorders of respiration may now be more conveniently studied.

Ætiology and Pathology.—The numerous causes and conditions which lead to disturbances of respiration can be brought within well-defined groups, and it is desirable in the first instance to study them from such a general point of view. This, however, only gives a superficial insight into the subject, and does not indicate the kind of disorder that is produced by each cause, or how it acts, while many conditions act in more ways than one; and, still further, in any individual case there may be more than one, perhaps several causes at work, all of which ought to be recognised. These causes and conditions may be summarised in the following manner, and it will be seen that several of them act indirectly on the respiratory process:—

1. *Conditions acting directly through the nervous system.*—These include: (*a*) Centric lesions in connexion with the brain, involving the respiratory centre, either directly or indirectly, such as injury, hæmorrhage, or a tumour. (*b*) Disease or injury of the upper part of the spinal cord, paralysing the nerves supplying the respiratory muscles. (*c*) Functional nervous disturbance, as from mere nervousness, emotion, hysteria, trance, or chorea. (*d*) Conditions affecting immediately the nerves concerned in respiration, either irritating or paralysing them, especially the pneumogastric, recurrent laryngeal, or phrenic nerves. These nerves may be themselves diseased, or affected by some neighbouring condition, such as a tumour. (*e*) Reflex causes, transmitted from the skin, as when cold water is dashed upon its surface; or from internal organs, as the stomach, intestines, or ovaries. It is important to remember that disturbances connected with the nervous system frequently aggravate disorders of breathing originating from other causes.

2. *Abnormal conditions of the blood.*—In this group are included conditions of the blood as a whole, namely: (*a*) Deficient quantity of blood, especially from a sudden or rapid loss. (*b*) Anæmia or hydræmia. (*c*) Deficient aëration. (*d*) A poisoned, impure state of the blood associated with narcotism, the anæsthetic state, pyrexia, the typhoid condition, uræmia, pyæmia or septicæmia, diabetes mellitus, and other diseases.

3. *Functional disorders, or organic diseases connected with the heart.*—These are common sources of disturbance of breathing of various kinds, depending upon the intimate relation of the nerves and nerve-centres governing the heart and respiratory organs; upon the effects the cardiac derangements produce as regards the pulmonary and bronchial circulation; or sometimes upon the direct interference by certain affections with the movements of breathing, by exerting pressure upon the lungs, especially the left, upon the left bronchus, or upon the chest-walls, and particularly the diaphragm. This last cause is only noticed in cases of great enlargement of the heart, or of considerable pericardial effusion. The breathing, however, is frequently disturbed in connexion with disorders of cardiac action; diseases of valves and orifices, especially the mitral and tricuspid; enlargements of the heart, particularly dilatation; cardiac degenerations; congenital malformations; and clotting of blood in the cavities of the heart.

4. *Abnormal conditions of the air inhaled.*—The physiological effects produced upon the respiratory act by various states of the air inspired are well known. These especially depend upon its composition; its temperature; its degree of moisture or dryness; and its condensation or degree of pressure. From a clinical point of view these effects have to be borne in mind, as they are more liable to be induced in certain diseases, and may also be made available for therapeutic purposes. The presence of certain gases in the inspired air materially affects the breathing, and some are in this way more or less poisonous. Solid particles floating in the atmosphere may also produce disorders of respiration.

5. *Conditions affecting the apparatus concerned in the respiratory movements.*—These refer to the chest-walls and the diaphragm, and they include: (*a*) Certain painful affections, causing the patient voluntarily or involuntarily to limit or modify the movements, such as the early stage of pleurisy, pleurodynia, or peritonitis. (*b*) Spasm or paralysis of the muscles, from any cause. (*c*) Organic changes, as undue softness or rigidity of the thoracic walls, cancerous infiltration, muscular atrophy or fatty degeneration, or acute or chronic inflammation of the diaphragm.

6. *Obstruction involving the main air-passages.*—This may be situated in the mouth, throat, nasal cavities, larynx, trachea, or primary bronchial divisions, and is due to a variety of causes, which cannot be discussed here further than to state that the obstruction may depend upon pressure from without; spasm or paralysis of the muscles of the larynx; some internal obstruction, whether from deposits, secretion, abscess (including also retro-pharyngeal abscess), foreign bodies, or new-growths; or organic changes in the walls of the tubes, leading to their constriction.

7. *Physical conditions independent of the respiratory apparatus, but interfering with it in various ways.*—These may lie within the chest, as in the case of thoracic aneurysm, or a mediastinal solid tumour or abscess. They act by compressing the lungs or heart, obstructing tubes, affecting nerves, or interfering with the moving apparatus. Or the cause of the disorder may lie in the abdomen,

such as excessive flatulence or tympanites, ascites, enlarged organs, ovarian tumours, or a pregnant uterus. They act mainly mechanically, by impairing the movements of the diaphragm. Breathing often becomes worse after food in cases in which it is difficult, in consequence of flatulent distension, especially when digestion is impaired.

8. *Conditions affecting the pleuræ.*—Any accumulation of air or fluid in one or both pleural sacs will necessarily tend to disturb respiration, as in pneumothorax, pleurisy, hydrothorax, or hæmothorax. It acts mechanically, and the degree of disorder will depend on the amount of the collection, the rapidity with which it takes place, the previous condition of the lungs, and other circumstances. Pleuritic adhesions and agglutinations also tend to embarrass respiration more or less seriously.

9. *Morbid conditions of the lungs.*—These have been left to the last, and it will be readily understood that all diseases of the lungs tend more or less to produce disorders of breathing. At the same time it must not be forgotten that these organs may be affected, even somewhat extensively, under certain conditions, without any obvious respiratory disturbance. Pulmonary diseases act in various ways, of which the most important are by affecting the circulation and the amount of blood in the lungs ; by interfering with the entrance or exit of air through the bronchial tubes ; by temporarily disabling or permanently destroying more or less of the pulmonary textures ; or by influencing the respiratory act through its forces, and especially by the impairment or loss of the elasticity of the lungs required for expiration.

CLASSIFICATION.—The arrangement of the numerous forms of disordered respiration is by no means an easy matter, and may be founded on different plans. Before giving that which seems to the writer to be a practical arrangement, he would urge the great importance of endeavouring to recognise in every case, by due investigation, what is the real nature of the deviation from normal breathing, and not merely to call it 'dyspnœa,' or 'difficulty of breathing.' Moreover, it must be remembered that there may be more than one form of disordered respiration in the same case.

The disturbance of breathing may be sudden, acute, or chronic ; and its several forms may be included under three main divisions, namely: (1) **Deficient Respiration.** (2) **Dyspnœa or Difficulty of Breathing.** (3) **Peculiar Disorders.**

1. **Deficient Respiration.**—This comprehends the following varieties :—

(*a*) *Slow breathing.*—The frequency of the respirations may be notably reduced, without any other obvious disorder. Or this may be associated with marked shallowness of the movements, so that in extreme cases breathing seems to have almost or entirely ceased, and can scarcely be recognised even by the most delicate tests. These deviations are observed in various conditions or diseases affecting the nervous system, such as hysteria, trance, shock or collapse, narcotic poisoning, and some cases of cerebral disease. They are accompanied by impairment or loss of consciousness, real or assumed, and with other varying symptoms. Sometimes the breathing is slow but deep, and may then be sighing, stertorous, or attended with flapping of the cheeks in expiration ; this is noticed in apoplectic conditions. These disorders of breathing do not obviously disturb the patient.

(*b*) *Restrained breathing.*—By this is meant that the patient makes a voluntary and conscious effort to restrain or modify the act, because it produces or increases some painful or other morbid sensation. It may be obvious at once to the observer, or may only be revealed when the patient is made to take a deep inspiration. The respirations are often increased in frequency, but may be below the normal. The entire movements may be affected, or only those of either the chest or the abdomen, or even only of one side of the chest. The early stage of pleurisy, peritonitis, and angina pectoris afford examples of diseases causing this disorder of breathing.

(*c*) *Shallow and feeble breathing.*—The most striking feature in some conditions is the extreme feebleness and limitation of the act of respiration. This has already been alluded to, as noted in some cases of slow breathing, but the frequency is often much above the normal, and the class of cases now under consideration differ essentially from those previously mentioned. The disorder indicates gradual cessation of the respiratory functions and pulmonary action, becoming more and more obvious, and gradually terminating in death. Little or no air is changed, and at last the breathing becomes a mere ineffectual gasp. This form of disturbance is observed in persons slowly dying from various causes ; in gradual filling of the air-tubes in fatal cases of bronchitis ; and in cases of apoplexy or narcotism. It is often accompanied by rattling or gurgling *râles*, audible to the bystander, due to the presence of fluid in the air-passages, which become by degrees filled up. It may follow certain forms of dyspnœa.

(*d*) *Ineffectual breathing.*—The derangement thus named can only be recognised by making the patient attempt to draw a full breath. He may then be conscious of an inability to perform this act satisfactorily, or to expand the chest properly. What is more important, however, is that this impairment of the respiratory act is often evident on objective examination, when it is seen that in certain conditions the most powerful efforts to breathe produce little or no result, and the movements are obviously more or less ineffectual, either as a whole, unilaterally, or locally. This may arise from various causes, such as paralysis or spasm of the muscles, rigidity of the chest-walls, distension of the lungs in emphysema, pleuritic and other conditions interfering with their expansion, and certain morbid changes in these organs themselves. Ineffectual breathing is frequently associated with some form of dyspnœa.

2. **Dyspnœa or Difficulty of Breathing.**—Without making too marked a distinction between them, and remembering that they may be variously combined, there are certain forms of disordered breathing, usually characterised as *dyspnœa*, which deserve separate recognition.

(*a*) *Obstructive dyspnœa; Inspiratory dyspnœa.*—This signifies that there is some obvious impediment or difficulty presented to the transmission of air through some part of the air-passages in respiration. The nature and severity of the disorder vary with the seat, cause, and degree of obstruction. Thus it may be that a swollen tongue, enlarged tonsils or other throat-condition, or retro-pharyngeal abscess, blocks up the passage more or less completely, and the patient breathes through the nose, often with obvious difficulty; or if some air passes by the throat, it does so with much noise, especially when the patient is asleep. More or less obstructive dyspnœa may also depend on conditions narrowing or blocking the nasal cavities.

The most important form of obstructive dyspnœa, however, is that which is connected with the main air-tube, and it usually attracts immediate attention. It may be associated with the larynx or the trachea, or with both, and in the case of the larynx is liable to exacerbations. The gravity of the phenomena varies with the degree of obstruction, but they are more or less of the following kind. The patient is usually conscious of a difficulty in the passage of the air during respiration, referred to some spot, which may become very distressing; the act of breathing is usually more or less laboured, and this may culminate in a violent effort or struggle to breathe. The frequency of respiration is often below the normal, or at any rate it is but little increased, while the relative length of inspiration and expiration is disturbed. The difficulty may be experienced only during inspiration, or during both divisions of the act of breathing, but is usually most marked in inspiration, though occasionally during expiration. Various noises are produced by the passage of the air through the narrowed part, usually classed as *stridor*, the breathing being termed *stridulous*; and to an experienced and trained ear these become of great importance as indicating the existence and seat of obstruction. Signs of deficient aëration of the blood are very liable to accompany this form of dyspnœa; and in acute or sudden cases, or if the obstruction is very marked, there is danger of actual suffocation which may occur rapidly or even suddenly. Physical examination will indicate that air does not enter properly into the lungs, as evidenced especially by recession of the lower part of the chest during inspiration, particularly marked in children, in whom this form of dyspnœa is likely to lead to most serious consequences.

The obstruction may be situated lower down in the respiratory tract, either in one of the main bronchial divisions, or in the tubes distributed through the lungs, and then the character of the disorder merges in that of ordinary dyspnœa, except that it is likely to be attended with various noises, and that the physical signs of deficient entrance of air into one or both lungs are evident. When there are evident objective signs of deficient entrance of air into the lungs, the condition is termed *inspiratory dyspnœa.* This difficulty, however, may also depend upon weakness of the chest-walls, and of the inspiratory muscles, as in rickets.

(*b*) *Excessive breathing—Ordinary dyspnœa.*—This is the disorder usually met with in various degrees, and it implies that respiration is carried on in excess. The act may be too frequent, or too powerful, or both, so that more than the ordinary amount of air is changed in a given time. The movements of the chest are more or less free under different circumstances. In severe cases the patient is obviously distressed, and the act of breathing is laboured, and may be noisy. Then the alæ nasi are seen to work; the patient cannot speak except in broken sentences, owing to want of breath; and there may be signs of apnœa. This form of dyspnœa is familiarly illustrated by the effects of undue exercise, such as running. Clinically it is associated in different degrees with numerous conditions, such as nervous disorders; fevers and other blood-conditions; many cardiac affections; conditions interfering with the action of the lungs, such as pleuritic effusion or abdominal accumulations; and various diseases of these organs, impairing their functional activity, especially if acute, such as pneumonia or bronchitis.

(*c*) *Shortness of breath.*—While associated with other forms of dyspnœa, this disorder frequently exists alone in various degrees, and it may be of much consequence in drawing attention to disease of a serious character. Shortness of breath signifies that the breathing becomes more or less hurried, and the individual becomes conscious of dyspnœa, after making some effort which ordinarily does not cause any such effects, such as walking rather quickly or upstairs, singing, coughing, stripping, or even taking a few deep breaths in physical examination of the chest. When at rest he may feel perfectly comfortable, and breathing is quite natural, but it is easily disturbed in the ways above indicated. This disorder is observed in general debility; very markedly in pronounced anæmia; in many cardiac conditions, especially dilatation and degeneration; in pleuritic effusion frequently; and in many cases of chronic lung-disease, such as phthisis or emphysema.

(*d*) *Expiratory dyspnœa.*—In the form thus designated the difficulty is experienced during expiration, which becomes prolonged and laboured, in some cases extremely so, the extraordinary muscles of expiration being called fully into play. The relative lengths of inspiration, expiration, and the pauses are thus deranged, and inspiration may become extremely short, even a mere gasp. There is often a sense of discomfort or even distress, and this is liable in certain conditions to be increased by exertion, after taking food, or in certain postures. Expiratory dyspnœa may be a prominent feature in some cases of obstruction of the air-tubes; but is essentially connected with impairment of the expiratory elastic force of the lungs in cases of emphysema, and of the chest-walls when they are rigid, these two conditions often going together. These causes are frequently aided materially by blocking-up of the bronchi, as the result of bronchitis; or by spasmodic contraction of these tubes, in connexion with asthma.

(*e*) *Orthopnœa.*—This is almost always combined with one or more of the other forms of dyspnœa, and the term indicates that the patient can only breathe at all, or at any rate with any degree of comfort, when the body is in a more or less upright posture. In some cases it is sufficient if he is propped up; in others he has to sit bolt upright in bed, or to bend forwards; in others still he is obliged to sit up altogether in some kind of chair, or even to stand, this being the only posture in which breathing can be carried on with any comfort. Cases of extensive cardiac disease, of acute pericardial and pleuritic effusion, of acute pneumonia, of asthma, and of aneurysmal or other thoracic tumours, afford illustrations of the causes of this disorder.

(*f*) *Paroxysmal dyspnœa.*—This may be of various kinds, but, as its designation implies, it signifies that the dyspnœa comes on mainly or entirely in fits or paroxysms. It is chiefly exemplified by paroxysms of laryngeal dyspnœa; by some cases of cardiac dyspnœa; and, above all, by fits of bronchial asthma. *See* ASTHMA, SPASMODIC.

3. **Peculiar Disorders.**—It is scarcely practicable to bring these under any definite subdivisions, and it will suffice to notice the very curious and often indescribable disorders of breathing observed in certain nervous cases; the interrupted, jerky, sighing, or yawning respiration which may be present in various conditions; and the peculiar disturbance generally known as *Cheyne-Stokes respiration*, but also termed *rhythmic dyspnœa.* This is rare, but may occur in connexion with certain cardiac diseases, especially fatty degeneration; Bright's disease; injury to the brain; and cerebral hæmorrhage, or other brain-lesions. It is characterised by the breathing at intervals becoming by degrees more and more rapid and deep up to a certain point; and then subsiding in the same gradual manner, until finally there is a complete cessation of respiration, with a dead silence, the pause lasting a variable time, and then the same series of phenomena being repeated.

EFFECTS.—Many of the disorders of breathing which have now been considered are not attended with any obvious effects, and are practically of little or no consequence. Moreover, it must be noted that patients may become so accustomed even to marked derangements of the function of respiration, that they are not conscious of any injurious results therefrom. Most individuals under such circumstances, however, are conscious of more or less discomfort or other sensations, referable to some part of the respiratory apparatus. These are very unreliable and vague in their meaning; but there are effects which give important information in many cases, and which depend either upon the want of due aëration of the blood, or upon the interference with the general venous circulation which disorders of breathing so frequently induce. These will vary, not only with the nature of the disorder, but also with its degree, and the rapidity with which it is set up. Thus there may be actual suffocation, sudden or rapid, or a condition approaching more or less that of asphyxia or apnœa (*see* ASPHYXIA). Or a chronic state of venous congestion and venosity of the blood may be set up, indicated by a tendency to cyanosis, with enlargement of the visible superficial capillaries; general chilliness and coldness of the extremities; mental apathy or dulness, with headache and other signs of morbid blood-supply to the brain; general languor, laziness, and muscular weakness; dyspeptic disorders; changes in the urine; and other well-known phenomena. In cases where the respiratory functions are chronically affected in children and young persons, in such a way that the blood is never properly aërated, growth and development are markedly impeded. Patients suffering thus may present a peculiarly stunted appearance. The features tend to become permanently thick and coarse; and the ends of the fingers and toes often become clubbed. In certain forms of dyspnœa the fat of the body tends to disappear; while the muscles of respiration not uncommonly become hypertrophied from excessive use.

TREATMENT.—The indications to be fulfilled in treating disorders of respiration, and the measures by which these are to be carried out, must obviously present considerable variety in different cases; and it will only be practicable here to offer a few general hints on the subject. In the first place, no treatment whatever may be called for in some instances; while in other cases nothing can be of any service. The primary indication should always be to attend to the cause of the disorder, and by curing, removing, or alleviating this, the disturbance may often be got rid of or materially diminished. This may be illustrated by treatment directed to laryngeal obstruction, anæmia, pleuritic pain or effusion, bronchitis, or cardiac derangement. By improving the condition of the blood when anæmia is present, breathing is frequently much improved, even when actual disease exists which disturbs it, such as phthisis or cardiac mischief. Attention to the condition of the air inhaled is in some cases of much importance, as regards its purity, temperature, degree of moisture, pressure, and other points. It must be remembered that some forms of dyspnœa actually require an atmosphere which contains an abnormal proportion of carbonic acid. Great advantage frequently results from giving proper instructions to patients as regards posture, avoidance of exertion, diet, the act of coughing, or even the act of breathing itself. This is especially important in certain forms of paroxysmal dyspnœa; and any cause which is known to produce any such attack should be carefully avoided. Moreover, the patient may sometimes be materially assisted in the act of breathing by mechanical means. Not uncommonly active measures are called for, for the purpose of relieving some more or less urgent form of dyspnœa. For this purpose various means are indicated in different cases, such as venesection, or local removal of blood from the surface of the chest; dry-cupping over this region; the internal administration of antispasmodics, stimulants, pulmonary sedatives, or other appropriate agents; inhalations of different kinds, in the form of gas, vapour, or smoke; subcutaneous injections of morphine or other active drugs; or the application to the chest of sinapisms, hot poultices, fomentations, or turpentine stupes. Treatment directed to the asphyxial condition may be urgently demanded, especially artificial respiration (*see* ASPHYXIA); and operative procedures, such as laryngotomy or tracheotomy, or intubation, may be called for in cases where the main air-tube is obstructed. In chronic cases, where the respiratory functions are imperfectly carried on, the conditions resulting therefrom must be remembered, and as far as possible obviated. Warm clothing is essential under such circumstances; and, if practicable, a residence in a genial and warm climate is often of the greatest practical service.

FREDERICK T. ROBERTS.

RESPIRATORY MURMUR.—The sound heard on auscultation over the lungs in respiration. *See* PHYSICAL EXAMINATION.

RESPIRATORY ORGANS, Diseases of.—SYNON.: Fr. *Maladies des Organes de la Respiration*; Ger. *Krankheiten des Respirationsapparates.* — The diseases which must be referred to in this article are those involving the special organs by which the function of respiration is performed. These comprise, first, the lungs, in which the process of respiration takes place; secondly, those organs through which the air is brought into contact with the blood, that is, the air-passages, and the agencies by which the movement of the air is effected; thirdly, indirectly, the organs by which the blood is brought into contact with the air, that is, the heart and blood-vessels.

FREQUENCY AND FATALITY. — GENERAL ÆTIOLOGY.—Before enumerating the several morbid conditions of the respiratory organs, it will be well to indicate the importance of this class of diseases—an importance which is due partly to the remarkable frequency with which they occur, and partly to the great fatality by which they are attended.

On reference to the returns of the Registrar-General, we find that, whilst during twenty-five years 5038·7 per million of persons living died of zymotic diseases, no fewer than 5840 died of diseases of the respiratory organs (including phthisis, and excluding the organs of circulation). This report further shows that the two great classes of diseases, the zymotic and respiratory, together accounted for almost one-half of all the deaths from every cause, including accidents. It must be remembered, further, that these figures represent only the number of *deaths* from these diseases, and that they give but a rough indication of the number of instances of sickness more or less grave, existing at the same time, from the same causes.

When we come to investigate more closely the nature of these diseases, it is not difficult to account for the frequency with which they occur. Complicated, delicate, and sensitive as the respiratory organs are in structure and function, including the pulmonary circulation, and the important changes in the blood which occur in the capillaries of the lungs; controlled, as the respiratory system is, by the nervous system, itself subject to a great variety of influences of a morbific character; dependent for the performance of the healthy act of respiration upon the continual movement of the mechanism which admits air to the lungs, namely, the chest-walls and the respiratory passages; affected also by the temperature of the air, subject as it is to great variety, by its purity, liable as this is to be contaminated by noxious gases, micro-organisms, and other impure particles, as well as to be damaged in its quality by alterations as regards dryness or moisture—it is easy to understand how the respiratory organs should become so frequently the seat of disease. Besides the more important influences to which we have referred, it will suffice to mention the effect that is exerted by such factors as occupation, age, sex, and climate. These several ætiological points will be found fully discussed in the articles CLIMATE; and DISEASE, Causes of. The influences of inheritance and diathesis also contribute powerfully to the causation of disease of the respiratory organs, more especially as predisposing elements in the production of phthisis, although the influence of both can be traced in certain other morbid states, such as bronchitis and asthma.

GENERAL PATHOLOGY.—The respiratory organs are liable to the several forms of injury and of disease which affect the other organs and tissues of the body. The injuries, including wounds and the presence of foreign bodies, are chiefly of surgical interest. The chief diseases are: (1) disturbances of circulation, including inflammation and its effects; (2) degenerations; (3) new-growths; (4) malformations and malpositions; (5) deformities; and (6) nervo-muscular disorders.

1. Disturbances of the circulation are found more especially in the mucous membrane of the air-passages, in the substance of the lungs, and in the serous coverings of these organs. Thus we have, as instances of inflammation, specific or otherwise—coryza, laryngitis, and tracheitis (including croup and diphtheria); bronchitis, in its several and varied forms; pneumonia, in its different varieties, and pleurisy; ulceration, which may occur in any part of the tract; and gangrene, especially of the lungs. Congestion more generally affects the lung-substance, but it is also to be met with in the mucous membranes of the passages. Hæmorrhage may occur from any portion of the air-passages, or from the substance of the lung itself, as the result of congestion, of tubercular disease and its effects, of disease of the heart, of diseases of the blood-vessels of the lungs, as well as from other causes. Thrombosis and embolism may be found in connexion with the pulmonary artery and veins.

2. Examples of degenerative disease are presented by the indurations which the cartilaginous tissues of the larynx, trachea, and chest-walls undergo; in the degeneration which is traceable in the air-cells in connexion with emphysema; the pigmentary and calcareous changes found in the bronchial glands and lung-tissue; and the caseous degeneration of inflammatory and new growths, such as tubercle.

3. The most important of the new-growths are tubercle; malignant disease in its several forms, whether primary or secondary, that is, extending from surrounding parts; syphilis in its various stages, more especially when affecting the larynx; polypi, adenoid over-growths, and other non-malignant formations in connexion with the nasal passages and throat; and hydatids.

4. Malformations and malpositions of the lungs and air-passages are of rare occurrence, and are of most importance when portions of the lungs are undeveloped, as in atelectasis.

5. Deformities implicate most frequently the walls of the chest.

6. Lastly, there are the various nervo-muscular affections comprehended under the names of whooping-cough, nervous aphonia, spasmodic cough, laryngismus stridulus, hiccough, spasmodic dyspnœa, including asthma, paralysis of the laryngeal muscles, of the walls of the chest, or of the diaphragm; also pleurodynia and intercostal neuralgia.

Although we have thus spoken of the several portions of the respiratory organs, and the diseases which affect them, as having, so to say, separate relations, we find no such isolation existing in the natural history of their diseases. Thus, for example, we seldom find inflammation of the lung in the absence of an affection of the pleura; whilst, when the like process affects the air-passages, it is rarely limited to one part, such as the larynx, trachea, or bronchi, without involving others, and it frequently passes on into the substance of the lung itself. Again, one morbid process may be, and is very frequently, associated with others: thus inflammation may lead to degeneration of tissue, or *vice versâ*; new-growths may give rise to obstruction of breathing, to inflammation, and frequently to hæmorrhage; and nervo-muscular affections may be either the cause or the effect of similar disorder or disease. Here, too, we have to observe the relation between heart-disease and disease of the lungs; likewise between morbid states of these organs and diseases of the abdominal organs.

GENERAL SYMPTOMATOLOGY.—The special symptoms of disease of the respiratory organs are founded essentially on disturbances which prominently affect their functions. Thus we have: (1) Disorders of the respiration, which are discussed in a separate article. (2) Obstructions and consequent disturbances of the circulation, which cause (*a*) congestion of the superficial or deep-seated organs, including the heart itself, the cavities of which may become dilated; and (*b*) hæmorrhages, especially hæmoptysis. (3) Disorders of secretions, and morbid products, giving rise to varieties of expectoration of more or less importance, as symptomatic of different forms of disease (*see* EXPECTORATION; and SPUTUM, Examination of). (4) Cough, a symptom seldom absent, and presenting many varieties. It is sometimes entirely referable to nervous disturbance, and of a reflex character; whilst at other times it is the means by which secretions are expelled, which might otherwise accumulate, and lead to further embarrassment and distress (*see* COUGH). The diseases of the respiratory organs are often attended by local and constitutional disturbance, as are diseases of other organs, such as pain, fever, wasting, and general debility, which will vary according to the nature of the morbid process and the part involved, as will be found fully described under special headings.

PHYSICAL SIGNS.—The function of respiration is so intimately associated with physical conditions and mechanical actions, that the respiratory organs afford special materials for the application of the principles of physical diagnosis, and the employment of clinical apparatus, including the rhinoscope, the laryngoscope, the stethoscope, the stethometer, and other instruments. The movements of air and the resonance of the voice through the several classes of air-passages, and into the minute textures of the lungs, cause characteristic sounds which are readily recognisable by the ear. These sounds become modified by the presence of disease, and afford characteristic evidence by which its existence and nature may be determined. The size, shape, and movements of the chest-walls afford also available evidence in physical diagnosis. Valuable information is afforded by a part that is resonant becoming dull, or by a part which should be dull becoming resonant. For further information on these points, *see* PHYSICAL EXAMINATION.

TREATMENT.—The diseases of the respiratory organs must be treated, whether for their prevention or for cure, on those general principles which are applicable to the treatment of the diseases of other viscera; with such modifications as may be called for by the special structure and function of the organs themselves, and by any special features which disease affecting them may present. These general principles, and their particular applications, are so fully set forth in the articles which treat of the several diseases of the different parts of the respiratory system, that it is not necessary to discuss them again here.

But, seeing the extreme frequency with which disease of these organs occurs, and its grave results, affecting alike the young and the old, those who labour and those who pursue only pleasure, those who live in cabins and those who live in castles—for *æquo pulsat pede pauperum tabernas regumque turres*—we may enter a little more fully on the subject of their prevention.

The principles which must guide us in this direction, independently of those which fall under the head of general hygiene, are fully treated of in other articles. *See* PERSONAL HEALTH; and PUBLIC HEALTH.

1. The first point to be insisted on is that a supply of *uncontaminated air* is essential for the prevention of lung-disease. Impure air is found in the homes of the poor, and in their close and crowded workshops; but it also abounds in the assembly-room, the banqueting-hall, and such-like places. The remedy for this evil will be found when people are made to feel that pure air is as essential to health and life as is unadulterated food; and when those who construct houses are convinced that they have no more essential duty to perform than that of devising means for the removal of impurities, and for the supply of pure air as well as pure water.

2. Pure air, however, can only be utilised by *freedom of the respiratory movements.* Many employments and trades involve constrained positions, which, no doubt, are often unavoidable; but even in such cases a knowledge of the fact that such positions are hurtful, with a desire to remedy the evil, will frequently suggest means for its mitigation. Like results follow a very different source of restriction on the movements of the chest, namely, the use of stays and other articles of dress, which not only compress the chest-walls and prevent their free movements, but even displace the contained organs. Much harm may also result from a practice which is called 'setting up' or drill in the army. The recruit is required to 'throw back the shoulders,' a position in which the pectoral muscles are made to act as constricting bands. The drill-sergeant aims at expanding and throwing forward the chest-wall, which he does not effect by merely throwing back the shoulders. This object can only be accomplished by teaching the person drilled to take deep inspirations, and to carry the chest-walls forward. The frequency with which diseases of the lungs, and of the organs of circulation within the chest, occur in the army is a recognised fact, which may in some degree be explained by this objectionable system of drill.

3. In the prevention of chest-disease it is necessary to guard against *vicissitudes of atmosphere and temperature.* This fact is more readily admitted than its teachings are adopted. Many delicate persons may escape lung-disease by wintering abroad. Most persons cannot entirely avoid exposure to these vicissitudes, but even in such cases counteracting influences are often practicable, and should always be employed. Again, there are those who, not always from necessity, having respired heated air, perhaps for hours, suddenly expose the delicate respiratory mucous membrane to cold air, or the heated surface of the body to a chilling draught. Disease thus originated is within the knowledge of all of us, and all know that such results might have been obviated by forethought. Lastly, there is the necessity for protecting the organs within the chest

by suitable covering. Suitable, for example, as is the dress worn by ladies during the day, the dress, or rather the undress, of many in the evening would seem almost designed to leave uncovered and unprotected, both front and back, as much as possible of the space which contains the lungs. Many instances of grave disease have thus originated. The remedy is not far to seek, in resisting the objectionable rules of fashion.

If more attention were given to obtain pure air for respiration, and to secure freer action of the respiratory organs, and if more precautions were practised in guarding against the effects of atmospheric changes, it is but a truism—which will not lose in force by being repeated here—to say that diseases of the respiratory organs would be infinitely less frequent in their occurrence than they are, and less serious in their results.

Finally, if these remarks apply, as they do, to the strong and healthy, it is unnecessary to urge the absolute necessity of insisting upon the practical suggestions which they convey in the case of persons whose respiratory organs are either constitutionally delicate by inheritance, or have been previously weakened by disease. Such are the chief victims of chronic lung-disease; and in no class of disease is prevention so absolutely essential.

Richard Quain.

REST, Therapeutics of.—In considering rest as a therapeutic agent it is requisite to understand its nature, its varieties, the indications for its use, and the ways of employing it. There are three chief varieties: (1) Rest of the *whole body* by sleep; (2) rest of the *mind*; and (3) local rest of a *diseased organ* or *inflamed part*. Of any of these, but of the third in particular, the practitioner may directly avail himself in the treatment of disease. The *modus operandi* of these varieties of rest consists in allowing the impaired, perverted, or lost functions of a part, or of the whole of the human frame, to be reinstated by maintaining the equilibrium of demand and supply. Hence it is only by availing oneself of the *physiological* properties of the component parts of the body, that rest becomes a therapeutic agent; and it must be borne in mind that *physiological* rest does not mean another variety, but rather that it regulates the employment of one or more of these varieties; and that, whether applied to the whole frame, to the mind, or to a localised part, it is the agent, in the guiding hands of the practitioner, which cures.

1. *Rest of the whole body and mind: repose in sleep.*—This form of rest, which is so necessary to the well-being and the due performance of the several functions of the human body, accomplishes two ends: the arrest of further waste of nerve-force and tissue-metamorphosis—a checking or 'diminution of chemical action' (B. Jones); and the repair of the organs employed in maintaining daily life. Rest of sleep, in a healthy man, does not of itself restore energy to the weary limbs, or vigour to the exhausted frame—it does but place the patient in the best possible condition for nature's recuperative powers to exercise their sway without detraction or interruption. Sleep may be looked upon as both a preventive of disease, and a curative means. The want of sleep and its attendant physiological processes of repair to the growing tissues of an infant—arising from whatever cause it may, such as teething, gastric catarrh, flatulence, or worms—becomes of itself a direct cause of arrest of development and of wasting diseases, and lays the seeds of future misery and early death. A healthy adult can for a time, with impunity, do without much sleep; but it should not be forgotten that the want of it acts as a great predisponent to the infection of fever and all contagious diseases, and that in any diseased condition, if continued for any length of time, it becomes a direct cause of death.

2. *Rest of the mind: relaxation.*—The light story, the strains of music, the change of scene and society, are familiar to all as among the many ways by which rest is given to the overworked brain and careworn mind.

The waste of nerve-force attendant on long and deep thought, and the many strains put upon the brain in these days of emulation and hurry, must be repaired, in like manner as muscular waste, by sleep and cessation from all mental work for a time. In too many cases has it happened that insomnia, the first indication of the disturbance of that equilibrium of the mental state comprehended in the term 'sanity,' has ended, before long, within the portals of an asylum, in epilepsy, insanity, or imbecility.

Hence, 'in all diseases,' writes Hilton, 'of no matter what nature, of the cerebro-spinal system, when the evidence of disease is in deranged function, it becomes our duty to look upon and treat the altered nerve-substance as we do contusion and laceration of soft parts and congestion of organs, and to give the brain absolute rest, to rely on nature's power to repair the injury or disturbance, and to avoid stimulants, which excite rapid circulation, as much as possible. The brain disturbed in its vital endowment becomes unequal to even its ordinary duties. It recovers itself slowly; it then soon becomes fatigued from use; and if claims are made upon it too soon after injury—that is, before structural and physiological integrity are re-acquired—the patient is very likely to suffer from serious disease of the brain. The brain requires absence from occupation, or rest, for its complete recovery, and this should be in proportion to the severity and duration of the symptoms it presents; in fact, the length of time which has been required by nature for the repair of the injury must be in proportion to the severity of the local injury; and the more severe the injury the longer the time required for perfect recovery of the functions of the brain. If this principle were only adopted generally and the plan carried out, we should not witness so many chronic diseases of the brain.' *See* PERSONAL HEALTH.

3. *Local rest.*—This, which may be called *mechanical rest*, is well known to every surgeon to be an agent of supreme value in the treatment of wounds, fractures, displacements, or inflammation of joints; as it is obvious that every movement to which a wounded or inflamed part is subjected must act on the one hand like the repetition of the original injury, and on the other hand like a continuance of the irritating cause. Thus rest is not only a negative advantage, as saving the patient from renewed injury or irritation, but a positive remedy, as it diminishes the heat of the body, reduces the pulse, and alleviates pain. Rest is of so much value in the treatment of inflammation, that in some instances no means will advance the cure without it, and numerous injuries of the body, external or internal, would do well with perfect local rest and nothing else.

It was on this principle that Pott treated all fractures of the extremities, by placing the limbs in a position of easy flexion, and thereby the muscles which had been thrown into spasm by the fracture were relaxed.

To a physician mechanical rest is an invaluable agent, and yet its benefits are not recognised in a practical way at all as frequently or as fully as they should be.

APPLICATION.—The application of rest in diseased conditions of the different parts of the body is so varied, and the cases in which it should be employed are so numerous, that it would be impossible to enumerate them all. In surgical practice rest is constantly used in the treatment of injuries and diseases. Here we shall only deal with its employment in medical practice, and shall select a few examples out of many to illustrate its benefit in different regions of the body.

A. **Diseases of the Respiratory Organs.**—The objects of the treatment by rest may be stated to be (Roberts): (1) To maintain structures, which are actually diseased, or in danger of becoming so, in as quiescent a state as possible; in short, to try to produce mechanical rest, as is ordinarily done in the case of a diseased joint. (2) To check or limit the entrance of irritating gases—be they noxious, or simply of a different degree of temperature or humidity from that of the internal part with which the air comes in contact. (3) To quiet the circulation through the organs which are being placed in a condition suitable for repair.

1. *Acute inflammation of the larynx and bronchi.*—The patient is to be placed in an equable and moderately high temperature, and the atmosphere impregnated with moisture; all speaking or using the voice must be forbidden, while the patient's wants may be made known by means of a slate and pencil (Hilton).

2. *Acute capillary bronchitis.*—In this disease, while *general* rest is to be maintained, the indications to relieve the congested right heart, and to remove the mucus which is causing the symptoms of asphyxia, predominate; and *physiological* rest cannot be obtained by mechanical rest alone. Here relief is attainable by restraining on the one hand the outpouring of mucus into the small tubes of the lung, and getting rid of that which is already poured out, by means of alkalis and stimulating expectorants; and by maintaining, on the other hand, the forces of the circulation, and relieving the overloaded right heart, by hydragogue cathartics, diuretics, and diaphoretics.

3. *Pleurisy.*—In addition to keeping the patient quiet, restraining breathing, and forbidding conversation, the most effectual way of employing rest to the inflamed surfaces of the serous membrane, is by mechanically fixing the side with adhesive plaster, as we would do for an inflamed joint. The forms of pleuritis to which this is most applicable are: Acute general pleurisy, seen early; dry pleurisy of a small area; that accompanying pneumonia, the result of a fractured rib; and in the advanced stages of phthisis pulmonalis, where fits of coughing and pain are produced by stretching of the bands of organised lymph which bind the costal and visceral layers together. The plan proposed by Dr. F. Roberts, and which has answered remarkably well in the hands of the writer, is as follows: Apply two or three layers of plaster, cut in strips of about four inches, thus: the first strip is laid on obliquely in the direction of the ribs, the second across the course of the ribs, the third in the direction of the first, the fourth as the second, and so on until the entire side is covered. A strip is also passed over the shoulder, which is kept down by another fixed round the side across its ends. Each strip should be long enough to extend from the spine to the sternum.

4. *Phthisis pulmonalis.*—The stage at which mechanical rest becomes a decided therapeutic measure is that of breaking down of the lung-tissue, and the formation of large cavities. Its application at an earlier stage is also useful in relieving the distress of breathing; but it seems most suitable as a means of checking the short hacking cough, and the stitch-like pains, produced by stretching of those parts of the lungs which

have been united by adhesive inflammation to the costal layers of the pleura. By means of strapping the upper part of the chest, corresponding to the disease, with diachylon spread on leather, and filling all the hollows previously with cotton-wool, so as to prevent all motion on inspiration or expiration, rest and quiet are obtained, and not only is cicatrisation encouraged, should such have commenced, but the risk of either hæmorrhage by rupture of an artery, or the laceration of the pleura pulmonalis and consequent pneumothorax, is averted.

B. **Diseases of the Heart and Blood-vessels.**—1. *Pericarditis.*—The mode of applying rest in this disease must necessarily be different from that which obtains in pleurisy, as actual arrest or even limitation, to any degree, of the heart's action—which theoretically and by analogy might be expected to be followed by the best results—would of course be out of the question. Rest must therefore be differently attained, by general rest and quiet, and by physiological medication. The advantages of perfect rest in the horizontal position are evident, as by it the attrition of the inflamed surfaces against each other is lessened by some 17,280 beats in the twenty-four hours, and thereby the tendency to effusion diminished, and resolution encouraged. The medicine above all others to produce physiological quiet is opium. When not otherwise contra-indicated, and when carefully watched, it is to be used freely, in grain doses every second or third hour, as it is remarkably little liable to produce narcotism.

2. *Internal aneurysm.*—For a long time, until recent years, this disease was looked upon as beyond the reach of medicines or cure. Valsalva saw the clue to treatment, and attempted to induce rest and such a state of the general circulation that the aneurysmal sac might be filled by the fibrin of the blood; but the means he adopted were not physiologically correct, and to Mr. Tufnell of Dublin is due the credit of having so modified the treatment as to obtain that rest which alone can cure the aneurysm. Tufnell's method may shortly be stated to be as follows: The patient is to be placed in a bright airy room on a prepared bed or couch, on which he must be contented to remain for eight or ten weeks. He must thus lie in the horizontal position, and not even for a moment assume the erect posture. Accordingly, the bed must be so constructed that the requirements of nature can be attended to without alteration of position. The diet is to be restricted to a minimum of solids and fluids. The patient's mind is to be freed from all anxiety, and pain and sleeplessness relieved by opium. The object of these means is to give rest to the aneurysm (1) by reducing the absolute quantity of blood circulating, without taking any of its ingredients from it by bleeding; (2) by rendering the blood hyperinotic; (3) by diminishing the rate and force of the current through the sac. The horizontal position in a healthy individual makes a difference of at least twelve cardiac beats a minute less than the erect position, and in disease this difference amounts to twenty or even forty beats. Taking it at the lowest rate of difference, it is evident that in the horizontal position the pulse-wave passes 17,280 times less through the body in the twenty-four hours. The aneurysmal sac is proportionately less often distended, and the threatened breach in the wall of the artery is averted by layers of fibrin deposited by the more slowly moving and concentrated stream.

C. **Diseases of the Abdominal Viscera.**—In the therapeutic consideration of disease of these organs the principle of rest is not less plainly indicated than in the other parts of the body we have discussed; and by neglect of so simple and yet so potent an agent all other treatment may signally fail to relieve or to cure.

1. *Diseases of the stomach and intestines.* The whole basis of treatment often depends upon strict diet, and in some cases temporary total deprivation of food, enemata supplying the requisite nourishment. Local rest can best be obtained by the physiological action of opium upon the vermicular movements of the intestines, and by avoiding all irritants or purgatives. Opium may be required in full doses, so as to arrest all peristalsis; and thus an inflamed or ulcerated surface is placed at rest, and nature is enabled to prevent perforation, and cure the disease. It cannot be too strongly stated that the injudicious employment of purgatives in threatened perforation is not only unscientific, but the worst possible practice, as it is almost sure to result in the death of the patient. This line of treatment by rest holds good in simple or cancerous gastric ulcer, Curling's ulcer, typhoid ulceration, and that due to inflammation of the appendix vermiformis. The practitioner will find it also his best guide and indispensable aid to cure in perityphlitis, hepatic abscess, ileus, after operations for hernia, and in various other conditions.

2. *Inflammation of the kidneys.*—As the skin and bowels may vicariously perform many of the excretory functions of the kidney, the first indication in acute nephritis is to relieve and rest that organ, by general rest, local depletion, and by calling vigorously upon the skin and intestines. In some cases where the equilibrium of secretion and excretion is thrown much out of balance, and where convulsions and dropsy point to an hydræmic and toxæmic state, we should use venesection as the readiest and most efficient means of attaining our object, of curing by rest.

J. Mager Finny.

RESTLESSNESS. — This signifies a condition of constant movement; the movements being random and non-purposive, or only semi-purposive and fitful in character. The condition itself may be due to the most various causes. Thus it may be met with in children who are the subjects of connate mental defects, and who are scarcely ever at rest during their waking hours; or it may be seen for a time, and especially in 'nervous' people under conditions of extreme mental excitement. In various forms of delirium, or of mania, either subacute or acute, restlessness also exists to a well-marked degree. Where it occurs in fevers to a notable extent it usually co-exists with delirium. Restlessness is likewise a prominent feature in patients who are suffering from severe and abiding pain in almost any part of the body; or in those who have suddenly lost large quantities of blood, either from the uterus or elsewhere. *See* JACTITATION.

TREATMENT.—This being a mere symptom, dependent upon very many totally different underlying conditions, its treatment in each particular case resolves itself into the treatment of the general condition upon which the symptom is dependent.

H. CHARLTON BASTIAN.

RESUSCITATION (*re-*, again; and *suscito*, I stir up).—DEFINITION.—The recovery from suspended animation or apparent death. In these conditions, of course, all signs of circulation and respiration have disappeared, but usually the failure of one function has preceded the other. For the purposes of treatment we may regard as (A) *syncope* those cases where the lips and mucous membrane are found pale and exsanguine; and as (B) *asphyxia* those where they are dark-coloured.

A. **Syncope.**—Syncope may arise (1) from mental emotion, sudden pain, or shock; (2) from drugs and poisons, including anæsthetics, especially chloroform; (3) from hæmorrhage, or anything which reduces the due supply of blood to the heart; and (4) from fatty degeneration or dilatation of that organ.

TREATMENT.—Place the patient horizontally on his left side, with the pelvis and feet raised. Nélaton has urged complete inversion of the body, but by its interference with the free action of the diaphragm this method may be injurious. The windows of the room should be opened; the face fanned; and a little cold water may be sprinkled on the forehead. Smelling salts being held to the nostrils, if natural breathing has not returned, begin *Howard's method* of artificial respiration: *Position of patient.*—Face upwards; a hard roll of clothing beneath thorax, with shoulders slightly declining over it. Head and neck bent back to the utmost. Hands on top of head. Strip clothing from waist and neck. *Position of operator.* — Kneel astride patient's hips; place your hands upon his chest, so that the ball of each thumb and little finger rest upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid cartilage, the fingers dipping into the corresponding intercostal spaces. Fix your elbows firmly, making them one with your hips. *Action of operator.*—Pressing upwards and inwards towards the diaphragm, use your knees as a pivot, and throw your weight slowly forwards two or three seconds, until your face almost touches that of your patient, ending with a sharp push which helps to jerk you back to your erect kneeling position. Rest three seconds; then repeat this movement as before, continuing it at the rate of seven to ten times a minute; taking the utmost care, on the occurrence of a natural gasp, gently to aid and deepen it into a longer breath, until respiration becomes natural.

This method is said to keep the passage through the larynx free without the aid of an assistant or any contrivance for the purpose, and is recommended for that reason. Artificial respiration must precede the use of the stomach pump, and be continued until either the pulse or natural respiration returns. Keep up the temperature of the body by hot blankets or hot bottles. Stimulating the heart by galvanism has been recommended, but it is a doubtful remedy. It is not easy to make it produce general and effective contraction, such as would cause the blood to move forward, and, failing to do this, it probably does harm by exhausting the irritability of those parts which it does excite. Ether, or nitrite of amyl, may be held to the nostrils. A little brandy and hot water, eau-de-Cologne and water, wine, or other stimulant, as sulphuric ether or sal volatile, is now to be given, with care that none of it enters the trachea. If swallowing is impracticable, inject warm fluids into the rectum. In cases of syncope from loss of blood, transfusion may be required. *See* TRANSFUSION.

B. **Asphyxia.** (a) *Asphyxia neonatorum.* The mouth and nostrils of the infant should be wiped dry; and the body freely exposed, whilst the head is allowed to fall back over the hand which supports the nape. A few drops of cold water may be sprinkled upon the chest, and the face should be fanned or blown upon for one minute only. Next inflate the lungs by blowing into the nose and mouth; and then squeeze the trunk. The body should now be immersed in water at 100°, from which the chest should be raised every half-minute and sprinkled with cold water. Sylvester's method of artificial respiration is the best. Marshall Hall's and Howard's methods may be used after the first inspiration has occurred, or together with mouth-to-mouth insufflation (*see* ARTIficial Respiration). Experiments made by Dr. Champneys show that Hall and Howard's methods of artificial respiration are absolutely useless as a means of directly inflating the lungs of still-born children; and also that Sylvester's method, and its modification by Bain and Pacini, introduce more air than any other method.

(b) *Asphyxia from breathing noxious gases.*—The body should be brought into fresh air; artificial respiration at once commenced, whilst an assistant should blow into the nostrils three or four times; and hot blankets and hot-water bottles applied.

(c) *Asphyxia from mechanical obstruction of the air-passages.*—The cause of obstruction must be removed, if possible, by adopting the inverted position of Howard's method. Coins or plum-stones may thus dislodge themselves. In the absence of forceps, a button-hook or the handle of a tablespoon may be useful, especially in the removal of a lump of hard food. Laryngotomy or tracheotomy must be performed the instant the pulse becomes imperceptible at the wrist.

(d) *Asphyxia from poisons or anæsthetics.*—In the asphyxia of advancing coma from narcotics and anæsthetics, the breathing may stop from failure of the medulla and respiratory tract. In this case artificial respiration, by simply compressing the chest at intervals of five seconds, may suffice, but very often there is the mechanical obstruction in the larynx to be considered. If raising the chin and throwing the head back do not effect a free passage of air, Howard's or some other method of artificial respiration should be commenced (*see* Artificial Respiration). It is well to understand that when the muscles of the larynx are paralysed, the glottis becomes valvular in action or partially so—that is to say, it permits air to pass outward freely, but only a weak current of air to pass inward. A strong current brings the sides together and gives rise to complete obstruction. This is chiefly caused by the drawing together of the relaxed arytæno-epiglottidean folds of mucous membrane; and in order to obviate this kind of obstruction, the folds should be tightened, by throwing back the head and raising the chin as far as possible away from the sternum. This will render it unnecessary to catch hold of the tongue with artery forceps, the treatment usually recommended.

(e) *Asphyxia from drowning.*—In asphyxia from immersion in water there are two serious complications, namely, first, the presence of water and mud in the air-passages, and, secondly, the depressing effect of cold. With the view of more effectually removing the water from the air-tubes, Howard gives the following rules: *Position of patient.*—Face downwards. A hard roll of clothing beneath the epigastrium, making that the highest point, the mouth the lowest. Forehead resting on forearm or wrist, keeping mouth from ground. *Position and action of operator.*—Place left hand, well-spread, upon the base of the thorax to the left of the spine; the right hand upon the spine, a little below the left. Throw upon them, with a forward motion, all the weight and force the age and sex of the patient will justify, ending this pressure of two or three seconds by a sharp push, which helps you back again into the upright position. Repeat this two or three times, according to the duration of the immersion, and then resort to the method described in the treatment of syncope.

The following rules have been published by the Royal Humane Society. They recommend the Sylvester method, but probably this and the modification by Bain, in which the anterior fold of the axilla on both sides is grasped with the clavicle and pulled upwards, are less useful than the Howard plan, which favours the patency of the air-passages.

Directions for Restoring the Apparently Dead.

I. If from Drowning or other Suffocation, or Narcotic Poisoning.—Send immediately for medical assistance, blankets, and dry clothing, but proceed to treat the patient instantly, securing as much fresh air as possible.

The points to be aimed at are—first, and immediately, the restoration of breathing; and secondly, after breathing is restored, the promotion of warmth and circulation.

The efforts to restore life must be persevered in until the arrival of medical assistance, or until the pulse and breathing have ceased for at least an hour.

Treatment to Restore Natural Breathing.

Rule 1.—*To maintain a free entrance of air into the windpipe.*—Cleanse the mouth and nostrils; open the mouth; draw forward the patient's tongue, and keep it forward: an elastic band over the tongue and under the chin will answer this purpose. Remove all tight clothing from about the neck and chest.

Rule 2.—*To adjust the patient's position.*—Place the patient on his back on a flat surface, inclined a little from the feet upwards; raise and support the head and shoulders on a small firm cushion or folded article of dress placed under the shoulder-blades.

Rule 3.—*To imitate the movements of breathing.*—Grasp the patient's arms just above the elbows, and draw the arms gently and steadily upwards, until they meet above the head (this is for the purpose of drawing air into the lungs); and keep the arms in that position for two seconds. Then turn down the patient's arms, and press them gently and firmly for two seconds against the sides of the chest (this is with the object of pressing air out of the lungs. Pressure on the breast-bone will aid this).

Repeat these measures alternately, deliberately, and perseveringly, fifteen times in a minute, until a spontaneous effort to respire is perceived, immediately upon which cease to imitate the movements of breathing, and proceed to INDUCE CIRCULATION AND WARMTH.

Should a warm bath be procurable, the body may be placed in it up to the neck, continuing to imitate the movements of breathing. Raise the body in twenty seconds in a sitting position, and dash cold water against the chest and face, and pass ammonia under the nose. The patient should not be kept in the warm bath longer than five or six minutes.

Rule 4.—*To excite inspiration.*—During the employment of the above method, excite the nostrils with snuff or smelling-salts, or tickle the throat with a feather. Rub the chest and face briskly, and dash cold and hot water alternately on them.

Treatment after Natural Breathing has been Restored.

Rule 5.—*To induce circulation and warmth.*—Wrap the patient in dry blankets, and commence rubbing the limbs upwards firmly and energetically. Promote the warmth of the body by the application of hot flannels, bottles, or bladders of hot water, hot bricks, &c., to the pit of the stomach, armpits, between the thighs, and at the soles of the feet. Warm clothing may generally be had from the bystanders. When swallowing has returned, a teaspoonful of warm water, small quantities of wine, warm brandy and water, or coffee should be given. Sleep should be encouraged. During reaction large mustard poultices to the chest will relieve the distressed breathing.

II. If from INTENSE COLD.—Rub the body with snow, ice, or cold water. Restore warmth by slow degrees. It is dangerous to apply heat too early.

III. If from INTOXICATION.—Lay the individual on his side on a bed with his head raised. The patient should be induced to vomit.

IV. If from APOPLEXY or SUNSTROKE.—Cold should be applied to the head, which should be kept raised. Tight clothing should be removed, and stimulants cautiously used.

How soon should alcoholic stimulants be given? Certainly not until natural respiration has been induced; and in cases of narcotic poisoning, not until consciousness has been restored. If, on the return of consciousness, the patient is in pain or faint, the inhalation of a few drops of ether or smelling ammonia is indicated. In the absence of these a few teaspoonfuls of brandy may be given. Hot tea and coffee should be the first refreshment swallowed, and in general it should not be pressed upon the patient, as vomiting is more exhausting than waiting a few hours for food.

J. T. CLOVER.

RETCHING (A.-S., *hræcan*).—An ineffectual effort at vomiting, sometimes accompanied by the expulsion of gas from the stomach. *See* VOMITING.

RETENTION (*re-*, back; and *teneo*, I hold).—This word is employed in medical science to imply that some material, whether solid or liquid, which ought to be discharged, is retained or kept back in a cavity or canal, either natural or artificial. Thus we speak of *retention of urine*, *fæces*, *menses*, and *bile*; and also of *pus* under certain circumstances.

RETENTION OF URINE.—*See* MICTURITION, Disorders of.

RETINITIS.—Inflammation of the retina. *See* EYE, AND ITS APPENDAGES, Diseases of.

RETRACTED ABDOMEN.—The abdomen as a whole presents under certain circumstances more or less depression of its anterior wall, when it is said to be *retracted*, and this may reach such a degree that the region becomes 'boat-shaped,' and its anterior boundary sometimes seems almost to come into contact with the spinal column behind. The bony prominences of the crest and anterior angles of the ilium, the pubes, Poupart's ligament, and the lower margin of the chest often stand out prominently. In some instances the retraction is partial, involving the lower part of the abdomen, while the upper part is distended.

A retracted abdomen frequently renders it more easy to investigate by physical examination the contents of this cavity; and it must be remembered that the condition may be associated with diseases of abdominal organs, which can then be readily detected, or even with abdominal tumours. It may, however, also itself give information of importance in diagnosis. The chief conditions under which a retracted abdomen may be met with, so as to be of clinical importance, are as follows: (1) In certain cases of disease of the brain or its membranes, and especially acute tubercular meningitis. (2) In some forms of intestinal colic, particularly that form associated with lead-poisoning—the so-called *painter's colic.* (3) As a part of marked general emaciation from any cause, but especially that due to starvation, or to chronic diarrhœa from intestinal ulceration and other conditions. (4) In connexion with chronic diseases of the œsophagus, stomach, intestine, or pancreas, causing obstruction in some part of the alimentary canal, so that food cannot be taken in, or is prevented from passing along the tube. Here the retraction is also partly due to the general emaciation.

(5) As one of the consequences of chronic peritonitis. It will be seen, from a consideration of the causes just mentioned, that retraction of the abdomen immediately results either from a spasmodic contraction of the intestines and abdominal muscles; general wasting; absence of food from and contraction of the alimentary canal; or peritoneal adhesions. It may be mentioned that marked temporary retraction of the abdomen is sometimes noticed in connexion with the act of breathing, in consequence of disordered action of the diaphragm. *See* DIAPHRAGM, Diseases of.

FREDERICK T. ROBERTS.

RETRACTED CHEST.—*See* DEFORMITIES OF THE CHEST.

RETROCEDENT (*retro*, back; and *cedo*, I go).—A term employed in connexion with certain acute diseases, when their prominent external manifestations disappear or, as it were, go back. Retrocession is often associated with the simultaneous occurrence of internal disturbance. The phenomenon is observed in gout, rheumatism, certain skin-diseases, and the eruptive fevers.

RETROFLEXION (*retro*, back; and *flecto*, I bend).—A form of displacement in which an organ is bent backwards upon itself. *See* WOMB, Diseases of.

RETRO-PHARYNGEAL ABSCESS.—SYNON.: Post-pharyngeal Abscess; Fr. *Abcès Rétro-pharyngien*; Ger. *Retropharyngeal Abscess*.

DEFINITION.—A collection of pus in the loose areolar tissue which connects the pharynx with the muscles lying upon the vertebral column, namely, the longus colli and the rectus anticus major.

ÆTIOLOGY.—This is a somewhat rare affection, and is more commonly met with in children than in adults, more particularly in those of a strumous diathesis. Idiopathic inflammation of this tissue, though usually assigned as one of the causes of the affection, is not often seen. More frequently the inflammation (and resulting abscess) is a secondary disorder, dependent upon an inflamed condition and suppuration of a post-pharyngeal gland, or caries of some of the cervical vertebræ or their cartilages. Amongst other causes, pyæmia has been noted. The disease has also been observed as a sequela to some of the acute fevers, notably scarlet fever; and, rarely, as a consequence of disease of the nose.

SYMPTOMS.—As in all disorders where inflammation plays a part, so here, the onset of the disease is marked by increase of temperature and pulse, nausea, general restlessness and malaise; and already some amount of soreness of throat is complained of. The degree of pyrexia and constitutional disturbance will vary with the condition and constitution of the sufferer. Soon this soreness of throat develops into the true characteristic pain on making the attempt to swallow, a symptom which is never wanting, and which goes on gradually, though slowly, augmenting, till almost complete dysphagia is established. Accompanying this, or soon after, is observed a peculiar stiffness of the neck, which, coincidently with the difficulty in swallowing, becomes more apparent with the progress of the disease. A certain amount of swelling of the neck may also be observed, specially towards the angles of the lower jaw. Difficulty in breathing is another prominent symptom of the disorder, which, more particularly if the abscess be large, becomes greatly aggravated when the patient assumes the horizontal posture. On first looking at such a child with its embarrassed respiration, its anxious expression, its cyanotic lips and cheeks, one might well be excused for momentarily diagnosing the case as one of croup, were it not that, loud and hurried as are the respirations, they are not of a whistling character. Here also the voice is altered: at first hoarse and indistinct, it assumes what is described as a snuffling tone, or a toneless character. On inspecting the throat, a round swelling is observed in the posterior wall of the pharynx, occupying the centre of the pharyngeal space, or more to one side, whereby the cavity is greatly diminished in size. The mucous membrane presents a livid colour. On passing the finger over the root of the tongue and beyond the soft palate, this swelling will be felt to be either hard and tense, or soft and somewhat indistinctly fluctuating, according to the stage of the disease. When the enlargement attains an extraordinary size it has been seen to project in front of the soft palate. A quantity of mucus usually fills the mouth. All attempts at swallowing are fruitless.

PROGNOSIS.—The prognosis in retro-pharyngeal abscess is always doubtful. Most usually well-pronounced cases terminate fatally—invariably so if the disease depends upon caries of the vertebræ.

TREATMENT.—Little can be expected in the way of arresting the disease. Usually it is well-pronounced before the physician is called to see the patient; and as it is most commonly met with in children, early diagnosis, before the formation of pus, is less easy. If pus have not yet formed, the part may be painted with weak solution of iodine. To enable the patient to swallow food, and to reduce infiltration, a 10 per cent. solution of hydrochlorate of cocaine may be applied. Ice may be freely administered, and is most grateful to the patient. So soon as the presence of an abscess is distinctly established, surgical interference must at once be had recourse to. Sustaining treatment is urgently demanded.

CLAUD MUIRHEAD.

RETROVERSION (*retro*, back; and *verto*, I turn).—A form of displacement in which an organ is turned back. *See* WOMB, Diseases of.

RE-VACCINATION.—The operation of repeated vaccination. *Sec* VACCINATION.

REVULSENTS (*revello*, I draw away). This term dates from the time of the humoral pathology, and signifies therapeutical measures which draw the humours from the part affected. Any detailed consideration of such supposed effects could only be interesting from an historical point of view.

R. FARQUHARSON.

RHEUMATIC ARTHRITIS.—SYNON.: Osteo-arthritis; Rheumatoid Arthritis; Rheumatic Gout; *Malum Coxæ Senile*; Fr. *Rhumatisme Noueux*; *Usure des Cartilages Articulaires*; Ger. *Arthritis Deformans.*

DEFINITION.—A disease of the joints, the essential nature of which is unknown; characterised by chronic inflammatory and degenerative changes, involving the various articular structures; and leading to deformity.

ÆTIOLOGY.—In a considerable proportion of cases, rheumatic arthritis follows ordinary acute rheumatism immediately, or it appears after an interval of several years, during which time chronic rheumatism of a milder degree may have been complained of. Persons of all ages may suffer, but the disease generally begins between twenty and forty. It is commonly believed to be more frequent in women. Depressing influences of all kinds, including acute diseases, menstrual disturbances, chronic uterine disease, frequent pregnancy, puerperal disease, superlactation, the menopause, prolonged physical exertion, privation, unhealthy surroundings, and mental distress unquestionably act as predisposing factors. The disease is hereditary, in the same form or as acute or chronic rheumatism. Gout is very often present in the family history, and not uncommonly tuberculosis also.

The influence of cold and damp as exciting causes is very marked. In some instances injury of a joint is the starting-point of the morbid process. Occasionally it follows gonorrhœal rheumatism.

ANATOMICAL CHARACTERS. — Two well-marked forms of rheumatic arthritis are met with, according as a single joint only, or several—perhaps all—of the joints are affected. The anatomical characters are identical in the two forms.

Examined at an *early* stage of the morbid process, an affected joint is found to be enlarged; the synovial membrane, capsule, and ligaments being distended and stretched by a considerable amount of effusion. The synovial membrane is hyperæmic, swollen, and thickened; its fimbriæ are enlarged and vascular; intra-articular fibro-cartilages, ligaments, and tendons are vascular and softened; and the articular cartilages are partially removed, leaving a roughened, vascular, porous-looking surface behind.

In the more *advanced* stage of the process the effusion is considerably less, or may be completely re-absorbed; and the capsule and ligaments are much thickened, or even partially calcified. The intra-articular structures, including fibro-cartilages, ligaments, tendons, and articular cartilages, may have disappeared in great measure, leaving little or no trace behind. Peculiar bodies, consisting of pendulous masses of fibro-cartilage, are attached to the interior of the synovial membrane; more rarely they are free. The articular cartilages, where their opposed surfaces are in mutual contact, are replaced by an ivory-like layer of bone; whilst at other parts the surfaces present a pink coloration, with small spots of more intense hyperæmia. The articular surfaces are variously altered in shape and size. Thus articular cavities are widened, and occasionally deepened, by enlargement of the circumference, in the form of 'lips,' or by the production of separate bony masses in the same situation. The heads of bones are enlarged; present similar 'lips' or sharp edges at their widened margins; become flattened at right angles to the axis of pressure; and thus preserve their relations with the corresponding cavities, but can be readily dislocated from them. The shafts of the bones may be considerably altered in shape, increased in size, and changed in density. The associated tendons are frequently dislocated from their course beside the articulations, and atrophied or actually absorbed. The corresponding muscles are similarly atrophied. Bursæ in the neighbourhood of joints may be distended with fluid, and contain fibro-cartilaginous bodies; periostitis may also occur. The anatomical changes in this disease frequently present a remarkably symmetrical distribution. Peripheral neuritis occasionally accompanies the arthritic lesions.

SYMPTOMS.—The symptoms of rheumatic arthritis in its condition of full development are exceedingly characteristic. The patient complains of pain and stiffness in connexion with one or more joints; and on examination these are found to be swollen, more or less deformed, and tender. The history of these changes in the joints proves to be that first one and then others of the articulations were the seat of acute arthritis, and became painful, tender, hyperæmic, and swollen; that the resulting enlargement had not completely disappeared before the acute symptoms recurred; and that, by a repetition of similar acute or sub-acute attacks, the joints have reached their present condition. Thus the disease, whilst chronic in its course, consists essentially at first of recurrent acute, or sub-acute, attacks, which increase in frequency whilst their effects persist, and so finally become fused, as it were, into a continuous whole.

The *local* symptoms and signs vary with the particular joint affected; but in every instance they are chiefly these—pain, tenderness, creaking on movement, impairment of mobility, enlargement, and deformity, in connexion with the joint, and atrophy of the associated muscles. The pain is generally distressing, and may render the patient's life miserable by its continuousness and severity, especially as it increases at night and prevents sleep. It is aggravated by movement, and there is tenderness on forcible disturbance of the articular surfaces rather than on pressure. Creaking or crepitation, audible and palpable, is a highly characteristic feature, which can be elicited and appreciated either by the patient or by the practitioner, and in the case of large joints may be so loud as to be audible at a distance.

The mobility of the affected joints becomes more and more impaired as the disease progresses—at first on account of pain, afterwards in consequence of anatomical changes. Thus the various joints may become fixed by a 'false' (very rarely a 'true') ankylosis, so that the hands cannot be closed; the wrists are immovable; the arms can hardly be removed from the side; the jaws are fixed; the head cannot be rotated; the patient may be unable to sit; and the knees, ankles, and toes may be similarly impaired in function.

The variety of deformity is almost endless; and the particular character it assumes depends as much on the joint involved as on the nature of the process itself. Thus the knee, elbow, wrist, and knuckles may present considerable intra-articular effusion, especially in the earlier stages; whilst the shoulder, hip, and intra-phalangeal joints exhibit more limited swelling and 'drier' signs. The terminal digital joints become cuboidal or 'nodous'; the middle digital joints assume a spheroidal shape, or are partially dislocated backwards or forwards; and the knuckles are the seat of a peculiar oblique dislocation of the fingers towards the ulnar side. The lower ends of the radius and ulna project backwards, and give a full appearance to the dorsum of the wrist, which may be further increased by extra-articular puffiness, carpal and bursal enlargements, and atrophy of the muscles of the hand and forearm. Altogether, the hands and wrists are the joints most frequently affected. The elbow-joint is swollen; and bursal collections—fluid and solid—develop over the olecranon. The shoulder presents signs of wasting, rather than of enlargement, due to atrophy of the deltoid and other muscles; the head of the humerus at the same time lies unnaturally forwards and upwards; and a corresponding depression is apparent behind. At the hip-joint the disease gives rise to flattening of the buttock, shortening of the limb, and eversion of the foot; enlargement can sometimes be felt in connexion with the head of the bone and acetabulum; occasionally the patient may be not only lame but unable to sit, and accordingly must either stand or lie constantly. The knee, a very common seat of the disease, is enlarged by the presence of considerable effusion in the earlier stage; and when this afterwards becomes absorbed, local bony growths are easily felt, giving increased breadth to the patella, and forming sharp crests at the lateral margins of the articular surface of the condyles. The disease, as it affects the ankle and foot, does not require special description. At the temporo-maxillary articulation rheumatic arthritis gives rise to obvious enlargement in front of the ears, and possibly to distortion or asymmetry of the chin. Prominent nodular swelling is the principal sign of the disease at the sterno-clavicular articulation. In the spine it chiefly produces rigidity, as well as pain locally and down the arms, and leads to a variety of permanent deformities, with which contractures and distressing spasms of the extremities are sometimes associated.

The *general* condition of the subject of rheumatic arthritis, when it is advanced, is one of debility and anæmia. The face is pale and expressive of suffering; the complexion is muddy. The skin is peculiarly inactive, and rarely perspires. The patient looks pinched, and complains of a feeling of cold; the extremities are often miserably cold and livid; and the palms of the hands are damp or even soppy. Pyrexia, rising to 101° with considerable remissions or intermissions, may be present in the active phases. Bodily activity is greatly impaired, owing to interference with the movements of the limbs; in many instances the patient is completely crippled and bedridden. Even the voice and the hearing may be impaired, from involvement of the laryngeal and auditory articulations. Pains in the muscles and along the nerve-trunks and in the extremities may accompany or possibly precede those in the joints. Myotatic irritability is frequently increased. The various bodily functions are feeble, and frequently deranged; and although the mind may be active, the condition is rendered wretched in the worst cases by pain, deformity, and helplessness. In a considerable proportion of cases (5·75 per cent., Brachet) the patient is the subject of chronic valvular disease of the heart. Dr. Kent Spender has drawn attention to the frequent occurrence in rheumatic arthritis of other symptoms variously associated with the disease: gastric crises; increased tension and frequency of the pulse, which may rise to 120 or more; excessive pigmentation of the skin, in the form of symmetrical patches, streaks, or spots; and yellow bruise-like blotches on different parts of the body.

COURSE AND TERMINATIONS.—The course

of rheumatic arthritis has been already described. Unless it be treated early, the disease progresses essentially towards deformity. Death from rheumatic arthritis is rare; its other distressing effects have been sufficiently indicated.

PATHOLOGY.—Great diversity of opinion prevails as to the essential nature of rheumatic arthritis. Whilst most authorities acknowledge acute rheumatism as a cause of rheumatic arthritis, many of them regard it as simply one of the many possible sources of chronic articular irritation. The view most generally held in this country appears to be that it is a disease distinct from rheumatism and gout, with which it was confounded until the time of Haygarth (1805). Mr. Hutchinson maintains that, in a certain number of instances, there is an element of gout, as well as of rheumatism, in the disease. Dr. Ord makes light of the diathetic element, and attaches most importance to a nervous factor in the pathology of this disease, which he regards as a dystrophy of joints, muscles, and other associated tissues, traceable to direct or reflex affection of nervous structures, or to general nervous depression. Dr. Kent Spender also holds that the affection of the joints is merely one sign of a profound nerve-disorder. Dr. Archibald Garrod argues strongly in favour of the dystrophic theory of the disease. The writer's experience is in favour of the strictly *rheumatic* nature of rheumatic arthritis, as was maintained by Todd, and by Charcot and French authorities generally. In many cases he has found that the morbid process started in an attack of ordinary acute rheumatism, as was originally represented by Adams of Dublin. In numerous instances the family history is distinctly rheumatic. The frequent association of heart-disease is very important evidence in the same direction. Finally, no sharp line can be drawn between acute and subacute cases of rheumatism; between subacute and chronic cases of rheumatism; or between chronic rheumatism and so-called 'rheumatic arthritis.' Whatever, therefore, the essential nature of rheumatism may be, the writer holds that all the conditions named are expressions of one morbid process, which differ from each other partly in intensity, and partly in the manner of their evolution. Sir Dyce Duckworth considers it a manifestation of a basic arthritic stock or diathesis—a rheumatic branch of this stock, and therefore a true rheumatism.

DIAGNOSIS.—The diagnosis of rheumatic arthritis necessarily depends upon the view entertained of its pathology. If considered a distinct disease, it is, as a rule, easily separated from gout by the entire absence of tophi about the joints and in the ears; by the history of the disease; and, in doubtful cases, by the absence of uric acid in the blood. From chronic rheumatism, as ordinarily defined, it is diagnosed by the amount of deformity present; but the writer holds that the two conditions are but different manifestations of the same morbid process. Chronic synovitis of traumatic or constitutional origin may be occasionally mistaken for rheumatic arthritis; but the presence of the latter disease in several joints, probably symmetrically, should remove all doubt. Rheumatic arthritis of the hip and shoulder has been described as 'dislocation' and 'intracapsular fracture.'

PROGNOSIS.—The prognosis of this disease is favourable as regards life; but unfavourable as regards cure, comfort, or ability to follow active bodily employment. The prognosis is much better in the rich, who can seek relief by change of climate in the earlier stages, than it is amongst the poor, in whom the disease must in a measure be allowed to pursue its progressive course.

TREATMENT.—The treatment of rheumatic arthritis must be applied in two directions: first, to arrest, if possible, the morbid process; and secondly, to relieve the distressing symptoms. In a large number of cases the second indication only can be fulfilled, for the disease is frequently too advanced, or the circumstances of the patient are too poor, to afford a prospect of cure.

In the *early stages* of the disease much can be done by energetic treatment, which must be partly constitutional and partly local. If circumstances permit, the patient should be advised to visit, according to the season of the year, the baths either of this country, of Germany, or of France, in summer; or the Algerian springs, the French Riviera, or Italy, in winter. Buxton, Bath, and Strathpeffer are the best home baths. Aix-les-Bains, Aix-la-Chapelle, Baden-Baden, and Wiesbaden may be recommended from May till September. The other places named, especially Hammam R'Irha in Algiers, are winter resorts. At all properly appointed baths massage now forms a part of the treatment. The climate of Egypt proves beneficial in some instances. A voyage to the tropics or subtropics will suit other patients. *See* MINERAL WATERS.

The most valuable internal remedies for rheumatic arthritis are cod-liver oil, iron, and arsenic. Cod-liver oil should be taken regularly if the digestion permit. Either iron or arsenic, or the two combined, should be taken in full doses for periods of weeks or months, and their effects carefully noted. Sir Alfred Garrod especially recommends the syrup of the iodide of iron. For the acute symptoms, particularly pain, salicylates may sometimes be given with success. In obstinate cases a trial should be given to iodide of potassium and to guaiacum.

The diet should be carefully ordered. Whilst all excess is avoided, as well as indulgence in malt liquors, and rich, indigestible dishes, a generous supply of mixed animal and vegetable food, and wholesome stimulants, will be found to be most suitable. The patient should take advantage of every possible opportunity of enjoying daily outdoor exercise in fresh air and sunshine. The clothing must be warm, flannel or other woollen material being worn both summer and winter. Great care must be exercised to avoid cold and damp, in the routine of daily life, and in the choice of a residence.

The *local* treatment is to be considered of hardly less importance than the constitutional. On the first appearance of the disease, counter-irritation should be freely employed around the joints by means of tincture or of liniment of iodine, which may be used until the skin becomes of a mahogany colour. The joints should then be carefully protected by cotton-wool or flannel, and kept at rest by means of bandages or other means of support, according to the part that is involved. At the end of the subacute attacks of the disease, efforts must be made to restore the healthy nutrition of the affected joints by removal of the support, and by local stimulation and graduated exercise. The joints that can be easily reached should be thoroughly fomented night and morning, by wrapping a piece of dry cambric or flannel around them, and sponging water over this, as hot as can be borne. After ten minutes of such treatment the joints should be unwrapped, carefully dried, and then thoroughly rubbed, either with a stimulating liniment, such as the turpentine or acetic turpentine liniment, with a mild mercurial ointment, or with some bland oil, such as cod-liver oil or goose-grease. A light warm covering is then to be applied. The effect of local treatment of this kind, if pursued steadily, is often remarkable, mobility being restored in cases where the joints have been useless for months.

In very *advanced cases*, especially in old subjects, it is manifestly unreasonable to expect much improvement. Anodyne treatment is then chiefly called for, and a good deal can be done in this direction by suitable mechanical arrangements and well-chosen local applications, the preparations of opium being, of course, the most successful. Phenazone may relieve pains and spasms of the crippled limbs. The general health will demand support by a well-regulated diet and the internal treatment suggested above.

J. Mitchell Bruce.

RHEUMATIC FEVER.—A popular synonym for acute rheumatism. *See* Rheumatism, Acute.

RHEUMATIC GOUT. — A popular name for several kinds of chronic joint-disease, especially rheumatic arthritis and chronic rheumatism.

RHEUMATISM, Acute (*ῥεῦμα*, a fluxion).—Synon.: Rheumatic Fever; Fr. *Rhumatisme Articulaire Aigu*; Ger. *Acuter Gelenkrheumatismus.*

Definition.—An acute disease; caused by certain obscure diathetic, climatic, or infective influences; and characterised by fever, sweats, and acute shifting inflammation of the joints and related structures.

Ætiology.—*Predisposing causes.*—Of the predisposing causes of acute rheumatism, the most important is inheritance, which can be traced in 27 per cent. of all cases ('rheumatic diathesis'). Previous attacks may be said to increase the liability to a return of the disease; but there is a limit to predisposition from this cause after several attacks. The great majority of first attacks occur in persons under the age of thirty; and the larger proportion of these between the ages of sixteen and twenty-five. At the same time, rheumatism is by no means uncommon either in children or in persons past middle life. Rather more males than females suffer; but, apart from other circumstances, the influence of sex is inconsiderable. Indeed, when all the varieties of the disease are included, it is more common in girls than in boys. Occupation and social position are important as predisposing causes. Laborious outdoor occupations, in which persons are exposed to chills, poverty, and the many evils associated with these, contribute to furnish the largest percentage of cases. Certain regions or districts, parts of districts, or even houses, appear to deserve the name of 'rheumatic,' from the number of residents who suffer from the disease, and from the probability that a person, otherwise predisposed to rheumatism, will be more likely to be attacked if he enter such an area.

Determining causes.—The most common exciting cause of acute rheumatism is exposure to cold and wet, or exposure to chill after severe exertion (*see* Personal Health: 5. Adolescence); but no definite ætiological relation can be traced between prevalence of the disease and weather or season. Rheumatism may suddenly make its appearance after a sprain or other injury to a joint, which may also determine the distribution of the disease in the articulations. Similarly, the order of invasion of the several joints is due in some instances to the amount of exercise to which they have been respectively subjected. An attack of acute rheumatism is occasionally referred to derangement of digestion, and of the functions of the liver, especially in subjects who have previously suffered. Indulgence in abundant, rich, or indigestible food will certainly determine a relapse in persons convalescing from the disease, and may possibly induce an attack in the predisposed. Bodily exhaustion or depressing mental influences, and acute diseases of other kinds, such as scarlet fever, erysipelas, and influenza, may excite rheumatism under similar circumstances. Exhaustion by lactation, or by chronic uterine disease, tedious convalescence, the puerperal state, and possibly simple despondency, may also act in this way in different instances. Some authorities regard the disease as infectious, and occasionally epidemic; others as caused by a drain poison. A specific micro-organism has been described as the *causa vera*.

ANATOMICAL CHARACTERS.—The *post-mortem* appearances in acute rheumatism are, on the whole, remarkably negative, not so much on account of the absence of morbid changes in the affected parts, as from the slight degree to which these changes have advanced. On opening an affected joint, we find moderate hyperæmia, with occasional ecchymosis, of the synovial membrane and fibrous tissues connected with the articulation. The synovial surfaces present a somewhat opaque, granular, swollen appearance. A considerable amount of inflammatory effusion occupies the articular cavity. This is generally a thin, clear, alkaline, albuminous fluid; occasionally it is turbid, with flakes of fibrin and cell-products; rarely purulent. The cartilages connected with the joint probably share in the inflammatory changes, especially if the process be severe; and the associated soft parts, including the tendons and their sheaths, are very frequently hyperæmic, and the seat of effusion. In the subcutaneous structures in young subjects there may be found, over the articular ends of the bones, and connected with the fasciæ and with tendon sheaths, small nodules of fibroid tissue, with a translucent appearance. These present the microscopical characters of rapidly growing connective tissue.

A fatal termination in acute rheumatism is always the result of some complication, intercurrent disease, or injury; and in such cases the non-arthritic lesions are necessarily the most important. Of these the most frequent are inflammation of the heart and pericardium, and congestion or inflammation of the lungs. Inflammation of the pleura is less commonly found; in rarer instances inflammation of the peritoneum, bronchi, larynx, meninges, testes, and renal tubules. When pyrexia has been high the solid viscera present granular degeneration, and are prone to rapid decomposition; and in cases of hyperpyrexia the blood is fluid. The blood has frequently been subjected to chemical analysis, but without any positive result of a pathological kind. The reaction of the liquor sanguinis is alkaline, as in health. The fibrin has been said to increase in amount to 1 per cent. instead of ·2 per cent. The amount of urea is not above the normal. Neither excess of uric acid, lactic acid, nor any other abnormal principle has been found in the blood during an attack of acute rheumatism. The presence of micrococci, zooglœar masses, and bacilli in the blood and serum has been described, but not substantiated. The red corpuscles are rapidly diminished in numbers during the acute stage, and rapidly restored during convalescence.

SYMPTOMS.—**General Description.**—After suffering for a time from aching pains in the limbs and trunk, flying pains and stiffness in the joints, malaise, chilliness, and sore-throat, the subject of an attack of acute rheumatism is seized with severe pain in one or more of his joints, experiences a chill or slight rigor, and is found to have several degrees of fever. The local and general symptoms quickly develop; and a striking picture is presented by the patient. He lies motionless in bed, flat on his back, with every joint at rest and carefully guarded. The neck, back, and legs are straight; the arms folded across the body, or extended along either side; the eyes alone are moved, and follow the practitioner as he approaches the bedside. The face is found bedewed with perspiration; and the rest of the body is profusely covered with sweat, which gives off a sour, acrid odour. The countenance is full, heavy, and expressive of a subdued feeling of pain and dread of movement; the complexion may be of a dirty, sallow colour, or even slightly jaundiced; the cheeks are probably flushed. The affected joints prove to be swollen and red; hot to the touch; remarkably tender; and the seat of pain, which varies much in character and intensity. One joint, or several, or nearly every joint in the body, may be found in the condition just described. The patient also complains of a feeling of illness, thirst, and anorexia; the tongue is foul and creamy; the throat may be somewhat sore; and the bowels are irregular. The pulse is frequent, soft even to dicrotism, and rather large. Respiration is somewhat accelerated; and there may be slight cough. The urine is scanty, high-coloured, very acid, and loaded with lithates. The skin is covered with perspiration, congested, and warm; and probably presents sudamina or miliaria in places. The patient's mind is perfectly clear, and his attention appears to be chiefly directed to the maintenance of the affected joints in the most easy position possible. Until successful in this endeavour he is restless and miserable; and even if he have obtained temporary relief and have gone to sleep, he is liable to be suddenly aroused by involuntary spasm of the muscles connected with the affected joints. The pain is so severe when the disease is at its height, that sleep cannot be obtained.

Such is the condition of a patient suffering from a fully developed attack of *uncomplicated* rheumatism. For a period, which would appear to be perfectly indefinite, these symptoms continue, varying considerably in intensity from day to day. But whilst the condition thus persists, the remarkable and characteristic fact is constantly observed in this disease, that the arthritic phenomena are at once transient and erratic, that is, that the rheumatism passes rapidly from joint to joint, the joints which were affected the one day being nearly well the next, and a fresh series swollen and painful. In this manner most of the joints of the limbs may have been affected in the course of a week, and the number of joints simultaneously affected is very variable. Thereafter the disease may make a further invasion of joints previously involved, and that repeatedly.

At last, the rheumatism appears to have exhausted itself: no fresh joint is attacked; and the parts last affected lose more or less completely the final traces, both objective and subjective, of the severe process which they have undergone. The patient now assumes a less constrained posture; the other symptoms decline; the perspirations disappear; the countenance becomes more bright; spirits and strength return; the tongue cleans, and the appetite is rapidly restored; the pulse falls in frequency; urine is passed in greater quantity, is less acid, and no longer deposits urates; and the temperature falls to the normal. The joints remain for some time, however, stiff, weak, and painful on movement. Relapse is not uncommon at this stage, or a little later. Anæmia and debility are almost constant sequelæ.

Analysis of Clinical Phenomena.—**Invasion.**—In the great majority of cases the patient gradually 'sickens for' acute rheumatism for several days before the symptoms are fully declared. He feels ill and out of sorts, chilly, indisposed to eat or work; sleeps badly; complains of sore-throat, aching pains in the limbs, and shooting shifting pains in the joints; and presents a sallow, patchy complexion, and a dull, heavy, yellowish appearance of the eyes. Altogether, the condition of the patient is very much that of the subject of a severe catarrh; the tongue, digestion, bowels, urine, and pulse presenting the ordinary characters of moderate fever. On careful examination it is found that the pains are of two kinds. The first kind are by far the more severe, and consist of severe muscular aching in various parts of the limbs and trunk; whilst the second kind are of the nature of flying pains in the joints or associated parts. The muscular aching appears to be similar to, or even identical with the 'break-bone' pains which are familiar in influenza, and in the invasion stage of some eruptive fevers. They are, therefore, not characteristic. The flying pains, which are, however, not always present —especially in first attacks, are actually situated in the articulations, for instance, the ankles, knees, or wrists, and are of the nature of sharp twinges, suddenly leaving one joint to return as quickly in another. Towards the end of the stage of invasion these pains become less 'shifting;' and when, as the patient will say, they have 'settled' in one or more joints, the rheumatism has passed into the second stage, that of the declared disease. Stiffness of the joints may also be present, especially in recurrent attacks.

In the invasion period the skin does not yet present the perspiratory activity which is so characteristic a symptom of acute rheumatism; but rather a moistness, greasiness, or oiliness, with heat and some congestion. The temperature is raised one degree or more. The sore-throat, which consists in pharyngeal catarrh, follicular tonsillitis, or even actual acute suppurative inflammation, is remarkably characteristic. The milder forms are soon lost in the more urgent symptoms.

The duration of the stage of invasion of acute rheumatism varies greatly, the flying pains in the joints 'settling' much more quickly in some cases than in others. In a small proportion of cases the disease is so rapidly developed that the stage of invasion is wanting. The patient on waking in the morning finds one or more joints affected; or he appears to be struck down during the day without the slightest warning; and instances are not unknown in which persons, thus suddenly seized with acute rheumatism, have been removed to hospital, for supposed sprain or fracture of the limbs. In rarer instances the feverish symptoms of the invasion stage may be well-marked without any pains whatever.

Declared Disease.—1. *Phenomena connected with the joints.*—The physical signs presented by a joint affected with acute rheumatism naturally vary much. The *swelling* is usually considerable, and is chiefly referable to effusion into the cavity of the articulation, fluctuation being frequently discoverable. It is rare for the periarticular effusion to be so abundant as to yield pitting on pressure. Neighbouring tendons and tendon sheaths may be swollen, as well as tender. The amount of intra-articular effusion (as well as the pain) greatly influences the position of the joint, but most joints are maintained in a position a few degrees removed from extension. Careful examination will determine the increase and the disappearance of the swelling, as the joints are attacked and recover respectively.

Pain is the most distressing of all the symptoms in uncomplicated rheumatism. It is always severe, and sometimes almost unbearable; but it varies with the different joints, and with the degree and duration of their involvement. In degree, it may be said to increase steadily for several hours; it remains excessive for a time; and it then slowly and steadily declines. Its character is very differently described by different sufferers. When a joint is attacked by rheumatism, the first sensation felt by the patient is one of soreness on movement. As the condition develops, the soreness increases to an ache of a subdued, throbbing character. In the course of a few hours the ache 'works up' into an intense pain, apparently associated with a feeling of cramp, the slightest movement of the articulation being almost unbearable. The severe pain now gradually declines—in some instances from the time the swelling reaches its height. After several hours the only pain that remains is a distressing sensation as if the parts had been severely bruised; and the effusion which accompanied the excessive pain having declined along with it, rest of the joint again becomes all-important, the very slightest movement being sufficient to restore the wearying ache. Finally, the pain completely disappears, and nothing remains beyond a feeling of stiffness and helplessness when the joint is moved.

Whilst the course of the pain of an acute rheumatic attack is usually such as has been described, it is greatly modified by a variety of circumstances, such as the particular joint affected, the age and sex of the patient, the condition of the nervous system, and the presence of certain temperaments. In some instances the pains are increased at night.

Tenderness is a constant and well-marked symptom of acute rheumatism. Reference has already been made to the effect of movement on the pain in its different stages, especially towards the end; and to the characteristic posture and anxious expression of the patient, who suffers intensely from the slightest shake of the bed, or even a footfall on the floor. Tenderness finally declines into the feeling of stiffness on movement.

The *redness* of a rheumatic joint is a simple pink blush of erythema, very rarely purpuric. Its intensity varies much, with the superficial or deep situation of the articulation, and it is therefore most marked in connexion with the joints of the hands and feet, the knees, and the ankles.

Heat of the affected joint is a well-marked objective sign of acute rheumatism. The skin over the articulation feels decidedly warmer to the hand than the surrounding parts; and this observation is confirmed by the thermometer.

The *electrical sensibility* of the skin connected with an acutely rheumatic joint has been described by Drosdoff as being remarkably diminished, the area of nervous alteration corresponding exactly with the area of redness, and its duration with the duration of the other local signs and symptoms.

The *favourite joints involved* in acute rheumatism are the larger articulations, especially the knees, ankles, wrists, shoulders, and elbows; the hip joint less frequently than the others. The fingers come next in order of frequency; then the toes; whilst the remaining articulations are more rarely affected.

Corresponding rather closely with the frequency of attack is the *favourite order of invasion*; the ankles being more frequently the first to be involved, then the knees, and so on. In other instances it is observed that the disease passes along the joints of the lower limbs, including the hips, to those of the upper limbs; frequently its distribution is symmetrical bilaterally; whilst in some cases it is unilateral, the homologous joints of the upper and lower limb being simultaneously invaded. The smaller joints suffer, as a rule, towards the termination of the attack.

2. *Subcutaneous nodules.*—In the course of acute rheumatism in children and adolescents, more especially in girls, crops of subcutaneous nodules are occasionally developed in connexion with the joints, tendon-sheaths, and bones. These nodules are small fibroid bodies, varying in size from a pea to an almond, and are readily discovered by stretching the integuments over the affected joint, which is best done by gentle flexion. They then stand out as pale elevations on the prominent ridges and prominences of the articulation; firm, scarcely movable, rarely tender, rounded in outline or occasionally acuminate. Several nodules are usually present on a single joint; but as they appear in crops, and have different stages of development, decline, and disappearance, their numbers and characters vary from day to day. The favourite joints affected are the elbows, knees, knuckles, wrists, and ankles. In connexion with the cranium the occipital region frequently presents a great crop of nodules. On the tendon-sheaths of the forearms and hands they are occasionally very distinct, and here they are movable. They have also been found on the vertebræ, clavicle, scapula, sternum, ribs, ilium, and long bones. A fact of significance is the usual association of subcutaneous rheumatic nodules, when they are large and numerous, with severe endocarditis and pericarditis.

3. *Disorders of neighbouring muscles.*—The muscular pains of the stage of invasion of acute rheumatism disappear in the declared disease, or are lost in the presence of more severe symptoms. They are replaced, however, by pains in the soft parts of the limbs related to the affected joints, especially the muscular insertions and fasciæ; and even the whole limb may ache, with much stiffness and a feeling of utter powerlessness. Painful twitchings are also common, especially during sleep; and when the acute pain has

passed off, marked muscular debility remains behind.

4. *Temperature.*—Acute rheumatism is attended by well-marked pyrexia, but this, like the disease as a whole, is variable in degree, course, and duration. The sudden invasion of the several joints, their speedy relief, the alternation of extreme bodily distress with comparative comfort, and especially the variety of pyrexic diseases with which the rheumatism may be complicated, would hardly lead us to expect a typical temperature curve. Nevertheless, in uncomplicated cases the fever follows a tolerably definite course. Pyrexia makes its appearance at invasion; it continues as long as the local symptoms preserve an acute or subacute character; and with them it declines and disappears. The *degree* of the pyrexia, in the great majority of cases, is in direct proportion to the severity of the joint-disease. Mild local symptoms—that is, moderate pain, short duration of symptoms in any given joint, and a small number of joints affected—are accompanied by moderate fever, ranging from 99° to 102° F. On the other hand, severe local symptoms—that is, severe pain, the full development of the several signs in the affected parts, and the simultaneous involvement of several joints—are attended by a temperature of 101° to 104° F. In another, but very small, class of cases the temperature, whatever it may previously have been, rises rapidly to an alarming height, so as to be entirely out of proportion to the joint-symptoms, which either continue as before, or even disappear. This condition of hyperpyrexia is regarded in the light of a complication, and as such will be presently described.

The *type* of the fever in uncomplicated cases is remittent, the thermometer rising ·25°, ·50°, or 1·0° F. in the evening. The primary elevation of temperature at the commencement of the disease is somewhat rapid; the decline or defervescence is decidedly more gradual, although it is generally irregular, being almost invariably broken by temporary rises, or interrupted by the supervention of some pyrexic complication. Brief recrudescences of fever, referable to excitement, exertion, or neglect of the primary alimentary and eliminative functions, are also common. The occurrence of a true relapse is marked by a return of pyrexia, which probably presents the same general characters as before.

5. *Skin.*—Profuse acid sweats constitute one of the characteristic phenomena of acute rheumatism. The brow is covered with drops which trickle down the face; and the whole body perspires profusely, and is bathed in an atmosphere of wet steam. Although usually universal, the sweats may sometimes be unequally distributed. It is doubtful whether any relation can be traced between the amount of perspiration and the hour of the day or night, the temperature, or the pulse; but it perhaps varies directly with the severity of the pain. The sweats continue throughout the whole attack, making their appearance at an early date, and disappearing gradually with the subsidence of the other symptoms. They do not intermit in the striking way of the sweats of the hectic or septic states, unless towards the end of a severe protracted attack, when the patient is greatly debilitated; but at certain parts of the day the skin may be found to be perspiring less freely, or even to be perfectly dry. The sweat of acute rheumatism possesses a peculiar sour, acrid odour; and this is so powerful, and pervades so thoroughly the neighbourhood of the patient when the blankets are disturbed, that the diagnosis of the disease can frequently be made from it alone. Like the sweat in health, it is acid in reaction, rarely alkaline from decomposition. No other test can be readily applied to it clinically. The rheumatic patient may complain of the unpleasant, but never of the 'weakening' effect of the perspirations which is observed in hectic fever; on the contrary, he may describe them as bringing great relief to the bodily condition. In less acute cases the skin may present a shiny or greasy appearance, rather than actual perspiration. When the sweats are severe, sudamina make their appearance, especially about the trunk; and in some cases the skin is covered with a profuse eruption of miliaria.

6. *Digestive system.* — The tongue is covered with a thick, white, moist fur, which varies closely with the rheumatic condition, and serves as a ready evidence of the same. The thickness of the coating is sometimes very great. Occasionally the tongue is dry; very rarely brown, baked-looking, or cracked. The sense of taste is, in a great measure, lost; thirst is urgent and difficult to satisfy; and the reaction of the saliva, or, more correctly, of the fluids of the mouth, is said to become acid. Appetite is lost, until the disease begins to decline, when hunger returns very early and urgently. Sore-throat occurs in some cases during the declared disease, but is much less common than in the stage of invasion. Sickness is rarely present. Dyspepsia, attended with flatulence, is common, unless the most digestible food only be given. Irregularity of the bowels is characteristic of acute rheumatism, either constipation or diarrhœa being almost constantly present; and the two conditions frequently alternate. Diarrhœa is perhaps more common in first than in subsequent attacks. The motions are dark and foul Pains in the belly are by no means rare and are frequently connected with diarrhœa, but they occur also in constipation; and at times they are accompanied by attacks of distressing flatulence.

7. *Circulation.* — The circulatory symptoms proper to acute rheumatism are modified by complications affecting the heart in a very large proportion of cases. When no special circulatory complication exists, the pulse is regular, 80 to 120, large, sometimes hard, more frequently soft or even dicrotic; but it naturally varies much with the severity and stage of the disease. The effect of the various complications on the pulse will be presently described.

8. *Respiratory system.* — The frequency of the respirations in uncomplicated rheumatism is somewhat increased; slight cough is occasionally present; and under these circumstances a few dry rhonchi may be heard over the chest. On the other hand, respiratory complications may be of a serious and even fatal character, and will demand consideration in their proper place.

9. *Urine.*—Throughout an attack of acute rheumatism the urine is scanty, high-coloured, and strongly acid; and it deposits a quantity of urates. Albuminuria is rare. Quantitatively examined, the urine is found to contain an actual excess of urea, and a considerable (but probably only a relative) excess of uric acid, sulphates, and colouring-matter (*see* SPECTROSCOPE IN MEDICINE); the water is below the normal amount; and the chlorides are diminished, although less so than in pneumonia. Lactic acid has never been found in excess. Any marked departure from these characters of the urine, especially in the appearance of more than a passing trace of albumen, is to be considered as a complication of the rheumatism.

10. *Nervous system.*—As a rule, consciousness and clearness of intellect are preserved throughout. Delirium is very uncommon; and when either delirium or stupor supervenes, it will generally be found that, in otherwise uncomplicated cases, the temperature has risen to an excessive height. Very rarely the pyrexia remains moderate in these circumstances, and such cases have been described by the name of 'cerebral rheumatism.' There is generally great distress of mind in acute rheumatism; and in other than first attacks, the previous experience of its severe and uncertain course and dangers, and the recollection of the pains and other sources of bodily discomfort, greatly affect the patient, and produce an amount of anxiety which is almost characteristic of the disease. Sleep is either impossible, or at best is constantly broken and unrefreshing, when the pain is severe.

11. *Expression.*—The debility or prostration, which forms an important element of fever from whatever cause, is present in acute rheumatism, but it is in great measure obscured by the expression referable to pain, and by the effort to preserve an easy position. Towards the end of an attack, when pain is subsiding and movement is comparatively easy, the patient and the practitioner begin to appreciate the degree to which the bodily weight and strength, and the richness of the blood, have been reduced. This loss is always great, and is sometimes extreme, varying, of course, with the severity and duration of the disease.

VARIETIES.—The description just given applies to a fully developed attack of acute rheumatism, without complication, of indefinite but not protracted course, and of favourable termination. It is only a minority of cases, however, that are of this nature. Occasionally the symptoms are very mild or the attack very short, in which event the rheumatism is said to be *subacute.* In another variety or 'type' of the disease, which is common in children, the articular manifestations are insignificant or even 'latent,' but cardiac, pleuritic, and other complications are severely marked, and the rheumatic process is peculiarly protracted in the form of relapses and recurrences. Again, as nearly as possible every second case proves to be *complicated* with some affection of the viscera, especially the organs of circulation and respiration. These departures from the 'typical' course of acute rheumatism, as it is called for the sake of description, will now be considered.

Subacute Rheumatism; Acute Rheumatism in Children. — Under the name of subacute rheumatism are comprised a variety of cases of the disease, which, whilst of comparatively little severity, exhibit the greatest possible differences in their other clinical characters. Several well-marked groups of these may be distinguished, and demand separate consideration.

(*a*) The *first* group of subacute cases is one in which the duration of the disease is unusually short—probably from one to three days. The number of joints affected is very small; and the general symptoms appear to be arrested before attaining any considerable severity.

(*b*) In a *second* group of subacute cases, after exceedingly mild invasion-symptoms, a single joint only is attacked, with little pyrexia, whilst the skin presents a shiny or oily dampness rather than true perspiration. The rheumatism disappears in a few days; or it shortly relapses in the same or in some other joint. This form of subacute rheumatism may be difficult to diagnose from gout.

(*c*) Widely different from the foregoing is another and the most common variety of subacute rheumatism. Such are many of the *recurrent* cases of the disease, and of the instances of first attacks in old subjects. It may be stated broadly that the first attack, or first and second attacks, of rheumatism are more severe than subsequent ones; that the severity diminishes with each recurrence of the disease; and that persons attacked for the first time after middle life suffer less than younger subjects. In all these cases, the phenomena connected with the joints, and the general symptoms, including the pyrexia and the sweats, are mild in degree, although by no means of short duration. In recurrent cases the patients are frequently the subjects of chronic heart-disease, in whom exposure to some of the determining causes of rheumatism has lighted up fresh endo- and peri-carditis, and therewith moderate fever and subacute rheumatism of the joints. The anxiety of the practitioner will be confined to the condition of the heart; but during the progress of the complaint, joint after joint may become painful, tender, slightly swollen, and red.

(*d*) *Acute Rheumatism in Children.*—There is a large and well-marked group of cases of rheumatism in children, in which the disease runs what may be called a *latent* course. The joints are so slightly affected that the characteristic signs and symptoms of rheumatism may be entirely overlooked. Children frequently pass through an attack of acute rheumatism without the true nature of the complaint being suspected by their medical attendant; and in other instances the diagnosis is first made on the discovery of one or other of its familiar complications, notably heart-disease. The child is feverish, and may or may not complain of pain and tenderness in the limbs, and of sore-throat. Moderate swelling and redness of the affected joints pass unheeded in the full and high-coloured body of the patient; and pain and tenderness in these subjects are either entirely disregarded, or referred to 'growing,' or to 'a cold.' Lastly, the sweats are much less profuse, or entirely wanting, the skin being hot, with but a moderate degree of fever. Whilst the disease in children runs this exceedingly mild course, but one which may develop a relapsing and recurrent type, it is accompanied, in a comparatively large proportion of cases, with acute cardiac disease—endocarditis and pericarditis—a fact which greatly increases the necessity for an early diagnosis. It is in these and other varieties in children that subcutaneous nodules are so often found; and pleurisy, erythema, and chorea may also be present. A more completely latent form of acute rheumatism has been described by Graves, in which articular symptoms are entirely wanting, whilst the other symptoms may be of the usual character, and follow the usual course.[1]

When these four prominent groups of subacute rheumatism have been described, there still remain a large number of mild cases, which are too indefinite to be treated of in a general article. All possible varieties of the disease will be encountered in practice, according as, on the one hand, the 'typical' course is pursued, or, on the other hand, the disease assumes a subacute character.

COMPLICATIONS.—Acute rheumatism is frequently accompanied by certain other affections, which modify its course, and greatly increase its gravity. The appearance of these complications is in every case anxiously apprehended; and the prevention of the most serious of them is regarded as the chief indication in the treatment of the disease. The principal are—inflammation of the heart and pericardium; hyperæmia and inflammation of the lungs, bronchi, and larynx; inflammation of the different serous membranes; various nervous affections, such as chorea, meningitis, and mental derangement; erythematous eruptions; scarlatina; albuminuria; hyperpyrexia; hæmorrhages; and, lastly, various concomitant or intercurrent conditions.

The relations of these complications to acute rheumatism are very various. The largest and by far the most important group, comprising cardiac inflammations, pneumonia, pleurisy, peritonitis, erythema nodosum, chorea, and meningitis, can only be described as having an intimate but still obscure *genetic relation* to rheumatism. This relation is indicated in many ways, such as the frequency of their occurrence during an attack of acute rheumatism; the comparative infrequency of certain of them in any other connexion; the manifest analogy that exists between the parts affected in some of them and the joints; the direct increase of their frequency with the intensity of the general rheumatic symptoms, that is, of the cause of the disease; the transient and migratory character which they may present, alternating as they sometimes do with each other and with the arthritis; their occasional occurrence before the joint-symptoms, or even without them, constituting acute rheumatism without arthritis; their appearance in the person of a blood-relation of a rheumatic subject; their amenability to anti-rheumatic treatment; and, lastly, their occurrence in the course of acute rheumatism as a part only of a manifestly general disease.

Other complications appear to be *effects* of rheumatism, such as albuminuria and mental disorder; and chorea is believed by some authorities to belong to this category rather than to the former. Scarlatina, dysentery, and profuse hæmorrhages are perhaps related to it *ætiologically*. Lastly, such complications as bronchitis, hyperpyrexia, and delirium tremens are to be considered as merely *concomitant* or *intercurrent* conditions.

The chief of these complications must now be considered in detail, in the order of their relative importance.

1. **Cardiac complications.**—These are by far the most frequent complications of rheumatism, being present in no fewer than 50 per cent. of all cases. The percentage of

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[1] *Clin. Med.*, p. 914, 1843.

acute cardiac disease is, however, less than this—almost certainly about one-third, the remaining cases being chronic, or chronic and acute cardiac disease combined. These numbers refer only to structural disease of the heart, namely, simple or ulcerative endocarditis, pericarditis, myocarditis, and the effects of these, singly or in combination. But, besides inflammatory affections, there may occur functional disorders of the heart, characterised chiefly by palpitation, cardiac distress, and the presence of various abnormal physical signs. According to some observers, the latter class are of as frequent occurrence as the former. It is more than possible that the evanescent cardiac murmurs by which they are recognised are sometimes produced by small vegetative growths on the valves which afterwards disappear.

The *circumstances* under which cardiac inflammation most frequently makes its appearance in acute rheumatism are—first, and specially, early age, rheumatic children rarely escaping disease of the heart, youths seldom, and the liability rapidly diminishing after the thirtieth year; secondly, severity of the rheumatic attack—with which the liability to cardiac complication increases directly—in the adult; thirdly, the female sex—women being more subject to rheumatic disease of the heart than men; and, fourthly, neglect of proper treatment during and after the attack.

The *time of appearance* of cardiac symptoms has been variously stated by different observers. As a matter of fact, they are generally discovered when the patient comes under observation; they certainly begin most frequently in the first week of illness; but they by no means uncommonly make their appearance in the second week, and may occur at any period.

Inflammation of the heart and pericardium are fully described under their appropriate headings (*see* HEART, Inflammation of: 1. Acute Endocarditis; 2. Ulcerative Endocarditis; and PERICARDIUM, Diseases of). The influence of the presence of cardiac complications on the course and prognosis of an attack of acute rheumatism is so important as to alter the whole aspect of the case, and to prove the chief cause of anxiety. Affections of the heart are by far the most common cause of death from rheumatism, immediate and remote; and even if they do not prove fatal, they constitute the most distressing of the remote effects of the disease. Rheumatic inflammation of the heart in children, like the arthritis in these subjects, is often slight at first, and is therefore liable to be overlooked or disregarded; but it is a process which—partly, no doubt, in consequence of this circumstance—may lead to grave disease.

2. **Respiratory complications.**—Diseases of the respiratory organs have been variously stated to occur in from one in every six to one in every sixteen cases of acute rheumatism; and in the larger proportion of immediately fatal cases they are the direct cause of death—frequently in association with endocarditis and pericarditis. The most common is pleuro-pneumonia; pleurisy alone the next: then pneumonia; severe bronchitis, pulmonary congestion, and laryngitis are more rare. They may probably occur at any period of the rheumatic attack; but the gravest forms will necessarily appear towards the termination, for the obvious reason that they so frequently prove fatal. The supervention of acute respiratory diseases is, as a rule, easily recognised by the appearance of their several symptoms and signs.

3. **Hyperpyrexia.**—This is one of the most alarming complications of acute rheumatism, but happily one of the most rare. The condition is fully described in another article (*see* TEMPERATURE). Hyperpyrexia may occur at any period of the disease; generally when the symptoms are fully developed; but even during convalescence. The principal indications of the approach of hyperpyrexia, which it is of the last importance to recognise, are flushing of the face; brightness and restlessness of the eyes; an eager, excited expression and behaviour; disappearance of pain and swelling from the joints, and arrest of the perspirations; delirium; and increase of the general symptoms of fever. On the occurrence of any of these symptoms in an otherwise uncomplicated case of acute rheumatism, the temperature should at once be taken, and the observation repeated every half-hour. If the body-heat prove to be over 103° F., and to be still rising, measures must be immediately adopted to prevent the hyperpyrexia, which is certainly threatening.

4. **Nervous complications.** — The reputed frequency of these complications has been greatly reduced since the discovery that the majority of the cases of so-called 'cerebral rheumatism' and 'rheumatic meningitis' are really instances of hyperpyrexia. These cases being excluded, the frequency of cerebral disturbance, in otherwise uncomplicated rheumatism, is not greater than in other pyrexial diseases. Cerebral embolism may occur from endocarditis; meningitis is very rarely observed; insanity has been described in connexion with acute rheumatism (*see* MANIA). Delirium tremens occasionally supervenes when there is a history of alcoholism. Other causes of delirium in acute rheumatism are pericarditis and the salicylates. Chorea bears a remarkable relation to acute rheumatism (*see* CHOREA). Occasionally it appears during an attack; and choreic twitchings may thus be the prominent symptoms during the first days of the illness, especially in children.

5. **Cutaneous complications.**—In a small proportion of instances, acute rheumatism, or a condition which practically cannot be distinguished from it, is associated with erythema; sometimes the arthritic symptoms, sometimes the skin-affection, being the first to appear, and the two conditions, or the erythema alone, being further associated with some of the complications already mentioned. Urticaria is less frequently seen in the same connexions. A remarkable condition, in which arthritic symptoms are associated with purpura, hæmorrhages, vascular thromboses, and possibly ulcerative endocarditis and its complications, is known as *peliosis rheumatica*, or *purpura rheumatica*. Sudamina and miliaria have been already noticed. *See* ERYTHEMA; PURPURA; and URTICARIA.

6. **Renal complications.**—Albuminuria does not occur in more than ½ or 1 per cent. of all cases of acute rheumatism; and the so-called 'rheumatic nephritis' has probably no real existence. The frequency of albuminuria is not greater than can be accounted for by renal embolism, the probable existence of chronic cardiac and renal disease, the possible association of scarlatina, and the presence of pyrexia.

7. **Serous inflammations.**—Peritonitis is a very rare complication, described chiefly by French writers. Rheumatic 'orchitis,' or inflammation of the tunica vaginalis, is occasionally met with. Rheumatic pleurisy and meningitis have been referred to.

8. **Gout.**—When acute rheumatism attacks a subject of the gouty diathesis, its symptoms may be considerably modified. The pain, swelling, and selection of particular joints have all a gouty character more or less; and whilst the disease is more amenable to treatment directed against the gout, it has possibly a greater tendency to lapse into a chronic affection of the smaller joints.

9. **Scarlatina.**—Scarlatina may be contracted in the course of acute rheumatism, or during convalescence. The occurrence of rheumatism as a complication or sequela of scarlatina—a much more frequent and important association—is discussed under SCARLET FEVER. The two diseases may mutually predispose to each other, by lowering the general health and increasing the liability to chill; but some authorities hold that many of the ordinary complications of scarlatina, as well as the arthritis, such as serous inflammations and nephritis, are essentially rheumatic.

COURSE, DURATION, TERMINATIONS, AND SEQUELÆ.—The course of acute rheumatism is extremely indefinite. The natural duration under expectant treatment is about three weeks. The average duration *of acute symptoms* under the same treatment has been estimated at nine days; it is rather less under certain other methods of treatment; and it is much prolonged by neglect. The entire duration *of an attack* is much greater than this, and necessarily less definite, namely, two to six or even ten weeks; and, speaking broadly, it increases with the age of the patient, up to middle age.

The patient being convalescent, a *relapse* of the disease by no means uncommonly occurs, after a few days or weeks. The fresh rheumatism may attain any degree, from a slight swelling, redness, and pain of a single joint, to a combination of the various symptoms, as severe as the first, or possibly more so, associated with fresh complications. Occasionally, two or even more relapses may occur.

Convalescence is generally protracted (before the health is perfectly restored); and it is very common to hear persons who have suffered from acute rheumatism state three or four months as the time they were 'ill.' Convalescence is accompanied by desquamation involving the hands and feet, and perhaps the body generally; and may be marked by obstinate anæmia. In many cases stiffness, pain, and weakness continue indefinitely in the joints and neighbouring muscles. Nodules may remain for months.

The great majority of cases of acute rheumatism ultimately end in recovery, the proportion of deaths as the immediate result of an attack being only about 4 per cent. On the other hand, a large number of persons suffer from remote effects of the disease, many of which are not only distressing, but likely to lead to death. Of the immediately fatal cases, the larger proportion terminate in the first or second weeks, and are associated with, if not actually due to, acute disease of the respiratory organs. The fatal cases which present cardiac disease, especially acute pericarditis, are scarcely less numerous. Altogether it may be said that from a half to three-fourths of all cases of death during acute rheumatism are referable to acute cardiac and pulmonary disease, either separately or combined. It is doubtful whether acute rheumatism *per se* ever proves fatal—that is, whether any patient dies from excessive pain, pyrexia, sweating, and consequent exhaustion. Hyperpyrexia is the most common cause of death next to pulmonary and cardiac complications. In a small number of cases, meningitis, acute alcoholism, and other complications lead to a fatal termination. In children the disease sometimes assumes an obstinately recurrent type, fresh inflammation of the heart and pleura, fresh nodules, and possibly chorea, making their appearance in various associations, and frequently leading to a fatal result.

The *remote consequences* of acute rheumatism are, on the whole, more serious than the immediate effects. In a few instances the disease leaves behind it a condition of joints which passes into 'chronic rheumatism' or 'rheumatic arthritis.' A more common effect is valvular disease of the heart, which is referable in the majority of instances to acute endocarditis occurring as a complication of rheumatism. It is impossible to estimate the number of cases of disease of the lungs, vessels, brain, kidneys, and other organs, which, in their turn, are caused by such heart-disease. It is also probable that the vessels suffer directly from the effects of rheumatism. When, in addition to these effects, we consider the debility, emaciation, and anæmia which it induces, the remote effects of pneumonia and pleurisy, of chorea, and of the other less common complications of rheumatism, as well as the liability to a return of the disease and its complications which seems to be engendered by a first attack, it is difficult to exaggerate the extent and seriousness of the ultimate results of this malady. *See also* TABES DORSALIS.

PATHOLOGY.—The pathology of acute rheumatism is still obscure, and in the present article it will be sufficient to enumerate the principal theories upon the subject.

1. *Lactic acid theory.*—Lactic acid accumulates in the body, and the symptoms are directly referable to the action of this poison upon the system (Prout, Todd, Richardson).

2. *Nervous theory.*—Chill of the peripheral parts of the body, especially of the skin and joints, causes disturbance of corresponding parts of the central nervous system; and this gives rise to pain and vaso-motor (?) or trophic changes of the same peripheral parts, and to fever (Canstatt; Seitz).

3. *Combination of* 1 *and* 2.—Chill causes accumulation or retention of lactic acid; this acts on the central nervous system; and the disordered nervous centres react upon the joints, &c., as in 2 (Senator).

4. *Combination of* 2 *and* 1.—Chill disturbs the nervous system; this disturbs metabolism generally; lactic or uric acid, or both, are retained, and act as poisons (Fuller, Latham).

5. As the result of chill, some poisonous product is formed within the system, which, according to individual proclivity or the nature of the products engendered, excites acute articular affection, or multiple neuritis, or acute spinal paralysis (Bastian. *See* NEURITIS, MULTIPLE).

6. *Infective theory.*—Chills are attended with the entrance of micro-organisms into the system, and endocarditis is the result. The joint-symptoms are secondary and embolic, as in pyæmic arthritis (Hueter).

7. *Germ theory.*—The disease is due to the presence in the blood of a micro-organism or a variety of micro-organisms (Salisbury, Immermann).

These organisms may enter the body by the tonsils, and their morbid activity may be confined to the lymphatic system, particularly the serous and synovial cavities (Mantle).

8. *Follicular tonsillitis* partially devitalises a number of leucocytes, which establish disorder of nutrition and perverted function in distant parts by accumulating within and without the capillaries, particularly when these are contracted by cold or by fright (Stewart).

9. *Malarial* or *miasmatic theory.*—Rheumatism is due to the presence in the system of a poison, which is of the nature of a miasm, entering from without. This miasm is generically allied to, but specifically distinct from, the miasm of malarial fever (Maclagan). Its development on the earth may be related to rainy weather; its dissemination to subsequent dry weather (Gabbet, Edlefsen, Pel).

Without attempting to criticise these theories, we may conclude that, whilst the true pathology of acute rheumatism cannot possibly be settled until the essential nature of fever is thoroughly understood, the most promising directions from which we may expect light to be thrown upon it are, first, the effect on the system of organic poisons, whether introduced from without, or produced within it as the intermediate products of nutrition; and, secondly, the intimate relation of the nervous system to the body-heat, to the skin, and to nutrition.

Under these circumstances it is impossible at present to estimate the respective significance and relative importance of the phenomena constituting the 'disease' rheumatism. But for the purpose of intelligible description, it is necessary that such of the phenomena as are only occasional in their appearance should be separated from such as are constant in a fully developed case; and that the latter should be treated as the essential symptoms of the disease, whilst the former are regarded as complications. The constant phenomena, in this sense, of acute rheumatism in the adult, are perhaps only three, namely, fever, sweats, and arthritis; whilst inflammation of the cardiac structures, lungs, and serous membranes would be included under the head of the occasional phenomena or complications. This plan of description of acute rheumatism has been adopted in the present article, for convenience sake only, and implies no actual criticism of the theories of the pathology of the disease just enumerated; although with several of them it necessarily cannot agree. It must also be understood that whilst these are the common manifestations of acute rheumatism, they do not constitute the disease, and, indeed, may all be present independently of it. The single symptom which, as far as is known, is peculiar to rheumatism, is the development and disappearance of subcutaneous nodules.

Diagnosis.—Although acute rheumatism can generally be easily recognised, its diagnosis is sometimes a matter of the greatest difficulty.

In the stage of *invasion*, it is most readily confounded with the acute specific fevers, including influenza and catarrh, in which pyrexia and aching of the limbs are prominent symptoms, and which are indeed at times complicated with rheumatism. If sore-throat be comparatively well-marked, and the development of the joint-affection slow, the practitioner may be led to diagnose simple catarrh instead of rheumatism, and to make light of a complaint which is about to develop into a serious disease. In every doubtful case a certain number of facts should be kept clearly in view, namely, the history of the attack; the possible occurrence of previous attacks of rheumatism; the family history; the absence of symptoms characteristic of other diseases, such as eruptions or coryza; the development of pain or tenderness in a definite joint, and acid sweats; and, most important of all, the discovery of the signs of inflammation of the heart.

In the second or *declared* stage, when one or more joints are involved, an entirely different group of diseases have to be diagnosed from rheumatism, namely, gout, 'rheumatic arthritis,' gonorrhœal rheumatism, pyæmia, glanders, and acute synovitis or arthritis of traumatic or diathetic origin. In doubtful cases the characteristic phenomena of rheumatism must be kept clearly in mind, especially the transient and erratic course of the arthritic symptoms, and the probable presence of cardiac complications.

Acute gout may generally be diagnosed by the sudden invasion at night of a single joint—probably the great toe, in a man of middle or advanced age; by the severity of the pain, which is relieved by the occurrence of a characteristic swelling of the part; by the history of previous attacks of the same description; by the insignificant amount of constitutional disturbance attending the arthritis; and by the strict localisation of tenderness, as compared with swelling, when the acme is passed. The discovery of uric acid in the serum will definitely settle the diagnosis of gout.

Pyæmia is usually associated with an injury or pre-existing surgical disease. Rigors are the rule, whilst they are the exception in rheumatism; the fever has a deeply remittent character; the sweats are distinctly intermittent; the arthritis is neither transient nor migratory, but may advance to suppuration of the joints; and symptoms of blood-poisoning, phlebitis, and extensive and multiple visceral disease shortly supervene. Still it is a fact, which cannot be insisted upon too strongly, that cases of pyæmia are frequently mistaken at first for acute rheumatism.

Gonorrhœal rheumatism may be recognised by being persistent, whether one or more joints be involved; by the type and degree of the pyrexia; by the absence of cardiac complications, as a rule; by the presence of conjunctivitis; and, most certainly of all, by the co-existence of a urethral discharge.

Rheumatic arthritis may be distinguished by the characteristic deformity of the joints.

For the diagnosis of glanders, *see* Glanders.

Ordinary *synovitis* is rarely multiple; is persistent and not migratory; and has an appreciable cause, whether traumatic or diathetic. *See* Joints, Diseases of.

The numerous difficulties which beset the diagnosis of subacute rheumatism, in children especially, have already been sufficiently dwelt upon.

Prognosis.—In a disease which runs so uncertain a course, and which may be complicated by such a variety of dangers, the prognosis is necessarily most uncertain. The proportion of fatal cases, and of cardiac complications, and the average duration of an attack, can easily be stated; but in a given case there is at first no positive means of foretelling what course the disease will run in any one of these respects. The prognosis must be specially guarded in persons worn out by mental or physical overwork or anxiety; in young women of full flabby habit, with tendency to anæmia and disturbance of the uterus, stomach, and circulation; and in women after delivery—all subjects in whom cardiac inflammation and failure, and pulmonary complications, are to be apprehended. Ill-declared, 'weak' symptoms, connected with the joints, indicating that the bodily strength and power of resistance are low, are less favourable than well-pronounced 'honest' pains and a warm sweating skin, which generally point to a favourable termination as regards life. It must, however, be observed that the risk of complications in some degree increases with the severity of the local symptoms. The probability of cardiac complications decidedly declines after the first week, but the possibility continues as long as fresh joints are being invaded. Rheumatism of the joints may be expected, on the whole, to run a mild course in children, but it must not be forgotten that the course of it may be protracted by the occurrence of relapses and recurrences; and that the danger of cardiac complications is very great. In old subjects it may be safely assumed that the disease will end favourably. The supervention of pulmonary complications, especially in association with cardiac disease, or of hyperpyrexia, should cause anxiety, as immediately threatening life. The prognostic significance of nodules is important. Remote danger from acute rheumatism is chiefly to be estimated by the occurrence of heart-disease, and by the nature of the same.

TREATMENT.—The difficulties which beset an attempt to give an exact estimate of the relative and absolute value of the different measures that have been proposed for the treatment of acute rheumatism, may be said to be almost insurmountable. Under the most favourable circumstances the number of carefully observed cases of any disease, subjected to a particular treatment, must be very large before a safe conclusion can be drawn respecting the result. The most favourable circumstance for therapeutical observations is manifestly uniformity of the course of the morbid process. This condition is as much as possible wanting in the problem before us. Rheumatism is a disease of practically indefinite duration, of infinite degree of severity, and beset with a number of complications. It is not always possible to estimate the duration of the attack when the case first comes under observation. Lastly, many of the recorded cases have been treated by such complicated methods, that it is frequently quite impossible to eliminate the respective effects of the various drugs administered. In approaching the question of the relative value of the different kinds of treatment, these facts cannot be kept too clearly in view, for perhaps no disease has been alleged to have been successfully treated by so many different remedies.

1. **General treatment.**—When called upon to treat a case of acute rheumatism, the practitioner must, in the first place, make certain special arrangements for the nursing of the patient. In addition to the ordinary measures proper in every case of an acute febrile disease which will probably prove of some duration, he must especially secure for the rheumatic patient perfect quiet, extreme gentleness of every necessary movement, and the prevention or relief of the discomfort attendant on constant and profuse perspirations. Next to a good strong nurse, and perfect hygienic arrangements of the sick-room, a proper bed is of the utmost importance in the general management of the case. The bed must be firm; standing on a firm floor; sufficiently narrow; and placed in such a position as to be readily accessible from either side, and to allow the attendants to reach any part of the limbs or trunk of the patient without interfering with the position and comfort of the other parts. Further, the bed must be 'made' as a 'rheumatic bed'; that is, a pair of blankets must be placed between the sheets—the one over, the other under the patient, so as to absorb the profuse sweat, and diminish the risk of chill from dampness of the linen. The patient should be furnished with a long flannel bed-gown, made to fasten with tapes down the front and along the arms, so that the chest or any joint may be reached with the least possible disturbance. Arrangements must be made for collecting the urine and stools in bed; and the use of a urinal and a bed-pan, or a properly arranged towel for these purposes, is imperative.

These nursing arrangements being completed, the physician may turn his attention to the consideration of the therapeutics proper of the case. Two indications have to be fulfilled, namely, first, the relief of local symptoms which may be urgent; and, secondly, the control of the morbid process and the removal of the general distress. An effort must be made to secure these ends by separate measures, or by following some system that will effect both. The various means at our disposal will now be considered, beginning with those which are at once the most simple and the most urgently required.

2. **Local palliative treatment.**—*Rest.* The most ready and satisfactory measure of a local kind for the relief of symptoms is the application of absorbent cotton-wool to the rheumatic joints. Cotton-wool is to be wrapped in some quantity around the parts, and secured by a moderately firm roller, or by a piece of warm flannel with the ends stitched together. The affected articulation is thus at once kept at rest and protected from cold and pressure; whilst uniform support is obtained. The relief obtained by this simple arrangement is often remarkable. The joints should be carefully sponged with warm water and soap, or warm water slightly alkalised with carbonate of sodium, before this or any other application; and the cotton-wool must be occasionally changed, especially if the perspirations be profuse. The principle of support and prevention of movement is more thoroughly carried out in a method of treatment that has found greater favour with Continental than with English practitioners. This method consists in placing the joints in splints, as they become affected; in bandaging them firmly; or in encasing them in plaster of Paris. The results are said to be very satisfactory; the pain being reduced to a minimum, the fever falling, and the course of the disease essentially shortened.

Anodynes.—When the pain is severe, and relief is not to be obtained by simple rest and protection, anodynes may be applied to the rheumatic joints. Opium in any of its ordinary forms, belladonna and its allies, and other familiar anodynes, may severally answer best in particular instances. These substances may be applied on the surface of lint, secured and supported by a bandage; or the affected part may be lightly rubbed or smeared with the anodyne preparation in the form of liniment, and then wrapped in cotton-wool or flannel, as already described. Heat is generally grateful to acute rheumatic joints, but in many cases it is felt to be useless in the acute stage unless it be quite extreme. Thus simple warm fomentations may give relief; but the patient may urgently demand their constant renewal, so that they may be almost scalding. There are obvious objections to such a plan of treatment. Extreme cold has been recommended by some authorities, notably Professors Esmarch and Hueter, in the form of ice. It is seldom used in this country.

A method of treatment once much in favour with some physicians consists in the application of blisters to the rheumatic joints. The blisters, usually of cantharides, are intended to act less as counter-irritants than as 'derivatives' or 'evacuants.' The late Dr. Herbert Davies, who introduced the blister-treatment in this country, contended that the rheumatic poison is especially abundant in the neighbourhood of the joints, and is actually separated with the blister-serum, and so removed from the body. In its original and complete form, the blister-treatment consists in applying a strip of cantharides plaster near every affected joint at the height of the inflammatory stage. In some cases the amount of blistered surface may thus be enormous. The serum is encouraged to drain away, and the surface heals in due course. It has been claimed for the blister-treatment that it relieves the pain, shortens the course of the disease, and lessens the tendency to cardiac complications. Of the first effect there is probably little doubt; the other effects are questionable; and statistics show that other methods of treatment are more efficacious in these respects. On the other hand, the danger of strangury, sloughing, and even pyæmia, and of the substitution of another form of severe pain for that dispelled, must be mentioned as objections to the employment of it. For these and other reasons, a modification of the blister-treatment has been proposed, probably at the sacrifice of the principle, namely, local blistering when a stimulant is demanded, in cases attended with much depression; when the joint-symptoms are unusually severe; when other less severe means have failed; or when the condition threatens to become chronic.

The local *abstraction of blood* by means of leeches, whilst it relieves pain, is very rarely called for, unless the arthritis be so severe and persistent as to threaten to lead to suppuration.

It is said that, in some cases, marked relief follows *galvanisation* of the rheumatic joints.

Certain lotions, of other than direct anodyne properties, have been recommended as local applications, to produce a specific effect upon the rheumatic joints, and thus indirectly afford relief. The chief of these are alkaline solutions, especially solutions of the carbonates of potassium and sodium, sopped into flannel wrapped around the joints. They may be combined with preparations of opium. Their value is somewhat doubtful.

3. **Medicinal treatment.**—The medicinal treatment of acute rheumatism should be commenced with a purge consisting of calomel or a mercurial and colocynth pill.

The use of the *salicylates* and *salicin*, introduced by Dr. Maclagan in this country, constitutes at present the routine drug-treatment of acute rheumatism; and the results obtained from it are certainly more favourable than from any other method. Fifteen to twenty-five grains of salicylate of sodium, twenty grains of salicylic acid, or fifteen grains of salicin, are given every one, two, three, or four hours, until the temperature falls to the normal, to establish rapidly the full therapeutical influence of the drug; after which the dose is very gradually reduced, so as to be simply sufficient to maintain the apyrexia and control the arthritis for several (seven to ten) days. Some authorities reduce the dose as soon as symptoms begin to yield. The salicylates are best given in watery solution, variously flavoured; salicylic acid in milk, or combined with solution of acetate of ammonium; and salicin in wafers, or in solution. Different practitioners prefer the different forms of the active substance; the salicylate of sodium is most extensively used. The salicylates reduce the temperature to the normal in the course of twenty-four to seventy-two hours, relieve the pain and other arthritic symptoms, markedly improve the condition of the patient generally, and diminish the risk of cardiac complications. The effect is most marked in first attacks, and in the early stages of an attack.

Unfortunately there are several drawbacks to the use of the salicylates.

The first of these is frequently urged as an objection to the employment of these agents. This is the fact that the rheumatism frequently returns as soon as their exhibition is stopped. On the second or third day after the disease has been checked, the symptoms may be again as severe as at first, the risk of cardiac complications again present. Thus it happens that, taking an average of a large number of recorded instances, the total duration of rheumatic symptoms is not less than nineteen days. Still, in a considerable proportion of cases no such relapse occurs, and the patients are completely relieved within forty-eight to sixty hours.

Secondly, whilst the salicyl compounds have a considerable influence in preventing complications, by rapidly controlling the specific morbid process, they do frequently fail to do so. Further, they appear to have little or no effect in subduing visceral complications that have already commenced. But if they do not arrest the endocarditis, pericarditis, or pleurisy, they will repeatedly dispel the arthritic symptoms that may recur again and again during the course of these internal manifestations of the rheumatism. The best rule to follow, therefore, is to restrain the arthritis and fever by means of sufficient but not excessive doses of salicylates, and to attend to the indications presented by any visceral complication that may arise. The salicylates will be resumed or increased, as the case may be, in the event of recrudescence, inasmuch as pyrexial rheumatism, however slight, always depresses the heart.

Thirdly, the salicyl compounds—particularly if abused—occasionally produce toxic symptoms, such as deafness, tinnitus, delirium, great frequency and weakness of the pulse, flushing of the face, lividity, sickness and collapse; and the termination may be fatal. The depressant action of salicylates on the heart and circulation is especially dreaded by practitioners, who are perhaps too ready to give them up for alkalis and quinine on the appearance of cardiac complications. In obstinately recurring cases, also, the protracted use of salicylates is believed to aggravate instead of controlling the rheumatism, by depressing the vitality of the patient. Of the two toxic influences, however, the salicyl compounds are, in the writer's opinion, less dangerous than rheumatism; and failure of the heart may be prevented by exhibiting digitalis, ammonia, strychnine, ether, or alcohol. Further, it has been determined that some of the worst of the toxic effects of salicylates were caused by impurities in the acid prepared artificially from phenol, and they are now removed in the process of manufacture. Salicylate of sodium can be given by the rectum to children or to adults when the stomach is intolerant of the drug.

Lastly, it must be confessed that in a very small number of instances the salicylates entirely fail to control the arthritis and fever. The practitioner ought not to conclude that this is the case until he has tried the effect of larger doses. Twenty-five or thirty grains of the sodium salt will often answer perfectly after twenty grains have been given without obvious effect. Salicin or salol (salicylate of phenol) may succeed under the same circumstances.

If the salicylates fail or disagree, recourse must be had to alkaline treatment or to some other method. Certain practitioners combine the full alkaline method with the salicylates from the first; others prescribe the alkalis in diminished doses, or equal parts of salicylate and bicarbonate of sodium. Possibly anæmia may be more marked, and convalescence more slow, after treatment with salicylates.

Before the introduction of the salicyl compounds *alkalis* were in general use in the treatment of acute rheumatism. The alkaline method consists in the internal administration of sufficiently large doses of certain alkaline salts, such as the carbonates, citrates, tartrates, and acetates, to render the urine quickly alkaline; in maintaining this reaction as long as the rheumatic symptoms continue; and in gradually allowing a neutral or an acid reaction to return by diminishing the dose as the disease declines. It is claimed for this method that, as the alkalis begin to exhibit their action on the system, the whole aspect of the case becomes more favourable, the general distress being alleviated, the temperature falling, and the local symptoms relieved; that these favourable effects continue to become more and more marked, until the rheumatic condition has disappeared; that the average duration of the attack is greatly shortened, not exceeding 6·75 days in the acute stage, and 13·5 days before the disappearance of pain; and that the proportion of complications is reduced as low as 2 per cent. only. In other words, it is asserted that in alkalis a direct antidote exists to the morbid influence (whatever that may be) which is the essence of rheumatism.

The plan of administering alkalis varies considerably. Some practitioners give large and frequently repeated doses, in order to obtain the speediest possible effect upon the system; others give a moderate amount, or variously modify the exhibition of the salts. Of the two plans, the first is unhesitatingly to be preferred. To obtain the full effect of potassium upon the system, not less than half a drachm of the bicarbonate in an ounce of water should be prescribed at once, either alone or with citric acid in the effervescing form; and the dose is to be repeated every four hours. An equal amount of the acetate of potassium may be added to each dose, if a still more rapid and powerful action of the alkalis be desired. The urine will probably become alkaline within twenty-four hours; and when once this effect has been obtained, it may very easily be kept up by continuing the alkalis at longer intervals, which may be further increased as the symptoms decline. The effect of the drugs upon the patient must be carefully watched, and the amount and frequency of the dose varied accordingly, or its administration stopped, if necessary. Finally, when the rheumatism is relieved, quinine may be added to the alkaline mixture; and as convalescence advances, the potassium may be entirely withdrawn. Constipation occurring in the course of treatment may be relieved by combining the tartrate of potassium and sodium, instead of the acetate, with the bicarbonate, tartaric acid being used to cause effervescence; or, if more obstinate, by a calomel and colocynth pill.

The alkaline influence upon the system may be further increased, in a very agreeable way, by supplying the ordinary effervescing potash or soda water as a drink, either alone, or combined with milk or with fresh lemon-juice. The patient may be encouraged to drink this in quantity, unless there be special indications to the contrary, such as cardiac distress. Should there be diarrhœa, lime-water may be substituted for the potash or soda water. Should alkalis persistently cause purgation, their administration must be discontinued.

A modification of the preceding plan has been highly recommended by Sir Alfred Garrod, and consists in the administration of quinine from the very first in combination with large doses of alkalis; as much as five grains of the alkaloid (thus in the form of a carbonate) being given every four hours.

The most obvious general remedies for the relief of symptoms are anodynes and antipyretics. So much benefit follows the use of opium in some cases, by relieving pain and diminishing nervous irritability, that it has acquired a reputation even as a specific. Although formerly given in large and frequent doses, such as a grain every three to eight hours, either alone or combined with mercury, opium is now seldom employed in acute rheumatism, except in the form of a moderate dose of Dover's powder, or of a morphine draught at night, to relieve pain and induce sleep. For these purposes it is employed by most practitioners, including those who adopt what they call the purely expectant method of treatment. The effect of the opium must be carefully watched, in the presence of the many complications which may possibly arise and contra-indicate its use.

Many other antipyretic remedies besides the salicylates have been recommended, such as phenazone, acetanilid, and phenacetin; quinine, tartar emetic, veratrum viride, digitalis, aconite, mercury, and various diaphoretics. The use of quinine has been already referred to. At the present time reliance is chiefly placed upon two powerful remedies of this class, namely, the cold bath or the wet pack, and salicylic acid.

The cold bath is the most powerful and speedy method of reducing the temperature in acute rheumatism, but is seldom resorted to except in cases of hyperpyrexia. When this condition threatens, the cold bath or the wet pack is to be unhesitatingly employed, in the manner described elsewhere (*see* TEMPERATURE). If the symptoms be less urgent, cold sponging of the trunk may be sufficient to reduce the temperature.

Hæmatinic remedies may be considered to be indicated by the great anæmia which accompanies and yet more markedly follows an attack of acute rheumatism. Dr. Russell Reynolds has recommended perchloride of iron in large doses; and favourable results have attended its administration.

Alcoholic stimulants, in moderate doses, are indicated when the symptoms are severe and protracted. Besides this routine use of alcohol, a special virtue was claimed for its free administration, as in other fevers, by Todd and his disciples, in preserving the strength and relieving the pain. Brandy must be ordered on general principles in cases attended with extreme depression, or with serious visceral complications, especially in the event of cardiac failure.

Tonics are indicated during convalescence; for example, quinine and iron, separately or combined either with alkalis or acids, and strychnine. Tonics must not be commenced too early.

Empirical remedies. — Lemon-juice appears to have proved successful in some cases of acute rheumatism in doses of eight ounces or less in twenty-four hours. Since the course of the disease is now known to be indefinite, the number of carefully recorded cases treated by lemon-juice is insufficient to permit a trustworthy inference to be drawn respecting its value. Similar doubts may be cast upon the alleged value of many other so-called remedies for the disease, such as propylamine and trimethylamine, in four- to eight-minim doses every two hours; nitrate of potassium to the amount of an ounce in the twenty-four hours; cynara or artichoke; and the cyanides of potassium and zinc. Colchicum was formerly given extensively in acute rheumatism, but has fallen into disrepute since this disease has been separated from gout. It may, however, be given with advantage for rheumatism in a gouty subject, to relieve pain. Guaiacum is useful in subacute lingering cases. Bromide of potassium has also been found very useful in American practice, probably by relieving pain and restlessness.

4. **Expectant treatment.**—Reference must here be made to the observations of the late Sir William Gull and Dr. Sutton upon the course of acute rheumatism when treated by simple rest, and the exhibition of a *placebo*. The comfort of the patient is secured by ordinary means; and small doses of opium are given to complete this effect when indicated. The results were favourable, but less so than those of several other methods of treatment, nine days being the average duration of acute symptoms. The number of cardiac complications was also small.

5. **Treatment of complications.**—For an account of the treatment of the complications of acute rheumatism, the reader is referred to the respective articles on each of these in other parts of this work (*see* HEART, Inflammation of; LUNGS, Inflammation of; PERICARDIUM, Diseases of; &c.). The plan of treatment which is being pursued for the rheumatism may have to be temporarily suspended, or possibly completely changed, on the appearance of any of these complications.

The state of the bowels requires the most careful attention. Constipation must be relieved by any of the ordinary means. Diarrhœa may be checked by lime-water or bismuth, or by a judicious dose of castor-oil, according to its cause. The surface of the body should be regularly sponged with a very weak tepid solution of an alkaline carbonate.

6. **Diet.**—The proper diet in acute rheumatism is the same as that in most other kinds of fever. The patient must be fed at short and regular intervals, night and day, with the most digestible forms of liquid nourishment; and may be encouraged to drink milk, or milk and soda-water occasionally. It must not be forgotten, however, that in all probability the system is already overloaded with the products of imperfect assimilation and transformation; that the digestive system is weak and irritable; and that the heart may be seriously affected by flatulence, and by the addition of much fluid or solid material to the blood. As the acute symptoms decline and appetite returns, fish, milk-puddings, and shortly afterwards chicken, sweetbread, and other 'light' articles of diet, may be cautiously allowed, and will be greatly relished. But, as a rule, the appetite returns before it can be safely indulged without risk of a relapse. Meat must be strictly forbidden until every rheumatic symptom has disappeared. Thirst is best relieved in the acute stage, as already stated, by aërated alkaline waters, either alone or in combination with lemon-juice or milk, the quantity given being regulated by the practitioner, and accurately recorded.

7. **General after-treatment.**—The general management of a case of rheumatism after the decline of the acute symptoms is scarcely less important than at the commencement of the attack. The patient should be encouraged to keep his bed for several days after the disappearance of the joint-symptoms; and this advice becomes imperative when cardiac complications exist. Rest and comfort of body and mind must be secured at this period, for the purpose of quieting the action of the heart, and allowing any endocarditic process that may affect the valves, and that probably outlasts the articular process, to subside quietly. The appetite must still be controlled, and daily evacuation of the bowels carefully attended to. All attempts must therefore be avoided at completing the cure of acute rheumatism within a certain small number of days. Even with these precautions, the first day of sitting up generally proves an anxious time to the practitioner in cardiac cases. Locomotion must be forbidden for several days, and permitted very gradually. When the patient is able to move about and go into the open air, the danger of a relapse during the first weeks must be carefully kept in mind. Sudden and extreme changes of temperature are especially to be avoided; and for this purpose the patient must be warmly clad, and studiously avoid draughts and exposure to cold in other forms. Hydrotherapeutic treatment is often successful in protracted cases, particularly if the articular symptoms are more prominent than the febrile. A course of baths and massage at Droitwich, Bath, or Buxton may give excellent results independently of medicine.

In the obstinately recurrent type of the disease occasionally met with in children and adolescents, our therapeutical resources and patience are severely taxed. In the majority of instances the heart is seriously involved, and demands chief consideration; but attempts to treat the cardiac disease are usually vain unless the associated rheumatism, *however slight*, be directly combated. The most rigid and continuous attention to diet, elimination, and rest, on the principles already laid down, is an indispensable element of the treatment—or, more correctly, the management—of rheumatism in this phase. As often as pain and pyrexia reappear, salicylates must be had recourse to if they can be borne, and iron and other tonics very cautiously resumed when the temperature has been reduced.

In persons who have suffered from acute rheumatism means ought to be adopted to prevent the return of the disease at a future time. The unfavourable influences to be chiefly avoided are cold and damp localities, exposure to wet, chill after exertion, free eating and drinking, and neglect of the liver and bowels. Woollen garments ought to be worn, summer as well as winter, in this country, of different thickness according to season and weather. These precautions are particularly important in the instance of rheumatic children. When the heart has been damaged in young subjects, so much attention is paid to the cardiac condition, with its attendant anæmia and impairment of nutrition, that the practitioner may forget that one of the greatest dangers to which the child is exposed is return of rheumatism and its complications.

J. Mitchell Bruce.

RHEUMATISM, Chronic.—Synon.: Fr. *Rhumatisme Articulaire Chronique*; Ger. *Chronischer Rheumatismus.*

Definition.—A disease of the joints, of chronic course; referable to certain obscure influences of a diathetic and climatic, or possibly infective nature; and characterised by various degrees of inflammatory and degenerative changes in the articular structures.

Ætiology.—The causes of chronic rheumatism, as far as they are known, are the same as those of the acute disease. The most powerful predisposing causes are inheritance, previous attacks of acute rheumatism, poverty, physical and mental exhaustion, and laborious occupations entailing exposure to chills. For the last reason men are more liable to the disease than women, and certain joints are its favourite seats. Chronic rheumatism is most common in middle life or advanced age, although by no means rare in young adults, and occasionally met with in children. Exacerbations of the symptoms are usually referable to exposure, and are accordingly most frequent and protracted in cold, wet weather. Occasionally they appear to follow influenza.

Anatomical Characters.—A variety of anatomical changes may be met with in chronic rheumatism, whilst in the least severe form of the disease no definite lesions of the articular structures can be discovered. In one form recurrent hyperæmia and effusion are found in connexion with the synovial structures, and with the articular and peri-articular tissues generally. In the most severe cases the joints are enlarged and deformed, in consequence of anatomical changes which appear to be identical with those of rheumatic arthritis. *See* Rheumatic Arthritis.

Symptoms.—The clinical characters of chronic rheumatism vary extremely in different instances. The leading symptoms of the disease are chiefly two, namely, pain and stiffness in connexion with the joints and associated structures, recurring indefinitely for any length of time, aggravated by cold, wet weather, and decidedly increased at night. More carefully investigated, the pains are found to have their seat in the joints, in the tissues of the limbs between the joints, or in both of these situations. Any or all of the articulations may be affected, but the site differs considerably in the different classes of the disease to be presently described. The pain is of a severe, aching, wearying character, attended with a sense of heaviness and uselessness of the limb; it is relieved by rubbing, and by exposure to a cold atmosphere; and is increased by slight warmth. Free use of the joint, although at first attended by much pain, often affords relief; whilst, on the other hand, undue exercise of the limbs during the day is liable to be followed by severe aching in the night. The affected joints also feel markedly dry and stiff, and creak on movement; but exercise or rubbing may remove these sensations.

These symptoms may last indefinitely for years, either recurring at intervals, especially in the winter and spring seasons, or being persistent almost day and night without intermission.

Such are the essential characters of chronic rheumatism. Its other features are so variable as to permit of the formation of several well-defined groups or degrees of the disease, as follows:—

First degree.—In this group of chronic rheumatic cases the pain and stiffness just described are the only articular symptoms present. No apparent anatomical change is produced, either in the joints or in the associated parts. The subjects of this form of the disease may be otherwise well, vigorous, and long-lived, in spite of the severe pains by which their rest is broken in cold, wet weather. They may or may not have, or have had, acute rheumatism.

Second degree.—In a more severe form of chronic rheumatism the pain is associated with obvious anatomical changes; and the disease assumes the character of a recurrent subacute rheumatism, making its appearance at intervals for years. The articular phenomena consist of redness, tenderness, and swelling, the hands being the favourite seat of the affection. These subacute attacks last for days, shifting from joint to joint; and leave behind them a distinct amount of swelling, which may not have completely disappeared before the next invasion. The process may thus, in course of time, lead to considerable enlargement, or even deformity, of the joints. In other subjects the joints slowly enlarge without pain.

Third degree.—Chronic rheumatism of the most marked degree generally occurs in persons who either have had, or may afterwards have, acute rheumatism; and is characterised by recurrent attacks of severe pain, tenderness, swelling, and hyperæmia of one or more joints, which lead to marked enlargement and deformity. A single joint may be affected at first; but the disease gradually invades the others, both large and small, until the whole articular system is involved. After some years the subacute attacks follow so closely upon each other, and their local effects are so marked, that the patient is never free from distressing pain; and the joints become ankylosed, dislocated, and otherwise disorganised. At the same time the general nutrition is gradually impaired; and the sufferer is anæmic, wasted, and debilitated. Chronic rheumatism of the most severe degree thus merges into, if it be not actually identical with, the class of disease known as 'rheumatoid' or 'rheumatic' arthritis. *See* Rheumatic Arthritis.

It is necessary to understand that the division just made of the leading varieties of chronic rheumatism into three groups, according to its degree, has been employed for the sake of description only. In a large number of instances the disease possesses certain characters both of the first and second degrees; whilst it is evident that cases belonging to the second degree may very readily advance to the third.

Course and Terminations.—The disease, as its name implies, is essentially chronic, generally lasting throughout the life of the individual whom it attacks, and leading to various conditions of debility and deformity, according to the degree of its intensity. In many instances the patient is rendered unfit for work; and such cases form a considerable proportion of the inmates of union infirmaries and other charitable institutions. Death as a direct result of the disease is rare.

COMPLICATIONS.—Myalgia and neuralgia, referable to rheumatism, are frequently associated with the arthritic trouble. Cardiac disease is met with in a considerable number of cases belonging to the third or most severe degree of chronic rheumatism, being usually referable to endocarditis, which complicated the original acute attack. Dyspepsia and calculous disorders are not infrequently seen in the subjects of the less severe forms. Iritis may be a very troublesome complication.

PATHOLOGY.—This disease is truly rheumatic in its nature, being intimately associated with acute rheumatism. In many of the best marked instances the patient has previously suffered from the acute disease, either immediately before or more remotely; in other instances one or more acute attacks occur in the course of the chronic disease. In another group of cases, a single member of a family will suffer from chronic rheumatism, ending in deformity, whilst his children, or his brothers and sisters, are attacked by the acute disease. The predisposing and exciting causes are also the same in acute and chronic rheumatism. Indeed, the two forms of affection run into each other in every particular, and are inseparably associated.

DIAGNOSIS. — If chronic rheumatism be regarded as a distinct disease from 'chronic rheumatic arthritis,' it is only in its most severe form that it can be confounded with the latter. A definite history of acute rheumatism; the presence of cardiac disease; and the non-involvement of such articulations as the jaw, the sterno-clavicular joint, and the spine, are considered to be features which render probable the diagnosis of true chronic rheumatism from rheumatic arthritis. But, in the opinion of the writer, the two diseases are identical.

The pain, swelling, heaviness, weariness, and weakness associated with varix of the lower extremities, sometimes resemble closely the symptoms of the milder forms of chronic rheumatism. Physical examination at once removes all doubt.

PROGNOSIS. — The prognosis of chronic rheumatism is favourable as regards life, but very unfavourable as regards cure; patients rarely losing the tendency to recurrence of pain throughout the whole of their life. Within a short time of the commencement of the disease it will be easy to discover which of the principal forms it is likely to assume; and the prognosis may be made accordingly.

TREATMENT.—The treatment of chronic rheumatism consists in (1) the relief of pain; and (2) the arrest of the rheumatic tendency, or the treatment of the disease proper.

1. *Palliative treatment.*—This chiefly consists in counter-irritation by iodine or cantharides; the application of anodynes, such as preparations of opium, belladonna, and chloroform; or friction with various stimulating liniments, containing camphor, soap, turpentine, or acetic acid. Regular warm fomentations night and morning, with very warm or even hot water, followed by rubbing and the application of a stimulating liniment under warm rollers, is one of the most efficacious methods of local treatment, the pains being prevented or relieved, and the stiffness removed often to a remarkable degree. Altogether, whatever view may be taken of the pathology of the disease, thorough local treatment of the joints and limbs will generally be attended with decided relief.

2. *General treatment.*—The most successful treatment of the condition of system with which chronic rheumatism is associated, is removal of the patient from the variable weather of England to the warm and settled climate of sub-tropical or tropical countries. In the case of the poor we have recourse to warmth of clothing and housing and relief from muscular exertion, as far as they can be secured, by admission permanently into charitable institutions. The subjects of chronic rheumatism require a nutritious, heat-producing, and at the same time attractive and digestible diet. Red wine may be allowed, the effects of it being watched. If acute symptoms, particularly pyrexia, supervene, liquid nourishment should be immediately substituted. The action of the liver and bowels must be carefully attended to. Iron, cod-liver oil, and arsenic are the drugs best suited to support the general health. Iodides and sulphur sometimes prove useful. Occasional large doses of salicylate of sodium will control more urgent symptoms. Courses of the mineral waters of Bath, Buxton, and Strathpeffer, in this country; and of many foreign baths, such as Aix-les-Bains, Royat, Aix-la-Chapelle, Wiesbaden, Baden-Baden, and Hammam R'Irha, prove invaluable in many cases to those who can afford to try them. As a rule, massage forms part of the treatment at these places; and passive movement of the joints, slowly but steadily increased in degree day by day, can be practised readily, with much hope of benefit. Exercise should be taken daily in the open air, unless the weather be unfavourable; and active movement of the affected joints may sometimes be carried out in spite of temporary pain. The ordinary Turkish bath may also afford temporary relief, if properly employed. *See* RHEUMATIC ARTHRITIS.

J. MITCHELL BRUCE.

RHEUMATISM, Gonorrhœal.—Synon.: Urethral Arthritis; Fr. *Arthrite Blennorrhagique*; Ger. *Tripperrheumatismus.*

Definition.—A kind of inflammation of the joints and associated structures, apparently infective in its nature, occurring in the subjects of inflammatory discharge from the genito-urinary mucous membranes.

Ætiology.—This disease, as its name implies, is generally referable to the presence of gonorrhœa. Occasionally it appears to originate in other kinds of inflammatory discharge connected with the urethra, such as gouty or traumatic urethritis or gleet; whilst, on the other hand, it has been observed as a complication of gonorrhœal ophthalmia without urethritis. It is much more common in men than in women, apparently from the more thorough cleansing of the female urethra during urination. An affection of the joints which strongly resembles it, is found in connexion with chronic uterine disease, or in the puerperal state; but so-called 'chronic uterine disease' in women is unquestionably very often gonorrhœal. Either a rheumatic or a gouty history is frequently to be traced in the patient. Previous attacks powerfully predispose to the return of the disease on the recurrence of urethritis, even in a mild form. The observation has also been made that persons who have suffered from the disease are frequently found to be, and to have been, peculiarly susceptible of urethral inflammation; excessive sexual intercourse being regularly followed by discharge in such individuals. It is practically certain, however, that these excesses, this predisposition, and this 'susceptibility' are all to be accounted for by the actual presence of persistent gleet; in other instances the man is re-infected by the wife. Thus successive attacks of urethritis and gonorrhœal rheumatism in the husband, along with leucorrhœa, chronic uterine disease, and tubal, ovarian, and peritoneal disease in the wife, may be referable to a single remote infection. *See* Gonorrhœa.

Amongst exciting causes, the most important appear to be injury of a joint, such as a sprain; a drinking bout; and chill during the course of gonorrhœa.

Anatomical Characters.—In recent cases of this disease the structures connected with one or more of the articulations are acutely inflamed. The cavity contains a variable amount of serous effusion, according to its form and size; the knee, for example, being considerably distended, whilst the digital joints are more moderately enlarged. The various component parts are hyperæmic and swollen; and the peri-articular structures full or even œdematous. In more advanced cases the joints are found to contain either sero-purulent or purulent materials; the cartilages may be eroded; and finally the articulations may become completely disorganised or ankylosed. The gonococcus has been found in the intra-articular effusion (*see* Micro-organisms). The cardiac structures are very rarely affected. The eye may present the ordinary appearances of catarrhal (not gonorrhœal) conjunctivitis.

Symptoms.—The disease, as ordinarily observed, commences at any period in the course of gonorrhœa—very frequently within a week of its appearance, but possibly not until it has degenerated into a slight gleet, or apparently disappeared. The patient is probably first aware of pain in the loins, or of swelling and pain in the soles of the feet, and very shortly these symptoms involve the ankles. In other instances the knees or wrist-joints suddenly become painful, tender, and swollen—possibly after strain or exertion. At the same time the patient is feverish, suffering from malaise and anorexia; the tongue becomes foul; and the pain, broken sleep, helplessness, gonorrhœa, and general illness give rise to restlessness and depression. Along with, perhaps even before, the articular symptoms, conjunctivitis sets in, affecting one or both eyes, and, although of a well-marked catarrhal kind, usually passes off in a few days with little or no treatment.

The physical signs connected with the joints are generally well-marked, the parts being hyperæmic and much swollen, both from intra-articular effusion and from exudation around. The amount of œdema of the dorsum of the hand or foot when the neighbouring joints are involved by gonorrhœal rheumatism, and of the upper part of the subcutaneous surface of the tibia when the knee-joint is affected, is often remarkable. The severity of the pain varies much. At times it is great, preventing sleep, especially as it is usually aggravated at night; in other instances it is extremely slight, and the condition is then more chronic in character. The pain is 'gnawing' or 'aching;' according to some patients, it is more severe before the swelling appears, according to others it is aggravated by the swelling. An important feature of the pains in gonorrhœal rheumatism is that in some cases they are not limited to the joints, but involve the fibrous structures, especially of the loins, the plantar and palmar fasciæ, the tendo Achillis, and the sheaths of nerves, such as the great sciatic. The muscles, or their aponeuroses, also appear to suffer; the fleshy parts of the arm, forearm, neck, and thigh, as well as the loins, being complained of. Frequently, indeed, the patient declares that the pains are universal. Stiffness is also felt, particularly when a joint or limb has been kept long in one position. Tenderness varies much, like the other phenomena, being exquisite in some instances, and entirely absent in others. Portions of the tendon-sheaths may be found swollen and tender.

The heart and pericardium are very rarely involved. *See* Heart, Inflammation of: 2. Ulcerative Endocarditis.

Such are the usual characters presented by a case of gonorrhœal rheumatism within the first week of its appearance. Under favourable circumstances the symptoms may decline; but in the majority of instances one joint after another is invaded by the morbid process, whilst those already attacked either slowly recover or continue affected, the disease becoming more extensive and protracted for several weeks or even months. Cases are met with in which all the joints of one or more limbs are simultaneously affected with gonorrhœal rheumatism, and have been so affected for ten to sixteen weeks; certain of the articulations being but recently invaded, whilst others are slowly recovering from the attack with which the disease commenced. In this manner every joint in the body may be invaded, including the jaw, the sterno-clavicular articulation, and the spinal column. The second toe is a favourite seat of the disease.

The class of case just described constitutes the most severe form of gonorrhœal rheumatism. Happily, in most instances the disease is much milder, only one or two joints being affected, and the process either ending with a sharp painful burst of acute synovitis, or, on the contrary, lapsing into a state of chronic intra-articular effusion, with neither tenderness nor pain.

When the disease is protracted, either in one or in many joints, the constitutional symptoms lose their acute character. There is little or no pyrexia; the appetite is fair; and the patient may even go about his work. But the health is gradually impaired, the patient being debilitated and depressed; in the most severe cases he may be completely crippled, unable to stand, write, or feed himself, and reduced to a condition of general helplessness and wretchedness.

Course, Duration, and Terminations.—The variable course of gonorrhœal rheumatism has been already sufficiently indicated. The duration of the disease is quite indefinite, varying from a few days to many months. The most unfavourable termination of the disease is ankylosis of the joints, with hopeless crippling; but this is rare. It never proves fatal directly. The disease, as already stated, is very liable to return. The urethritis is contagious, and the writer has seen husband and wife suffering together from the disease.

Pathology.—Opinion is still divided upon the essential nature of gonorrhœal rheumatism. Three leading views may be mentioned. It is believed by some pathologists that 'gonorrhœal rheumatism' is nothing more than acute or subacute rheumatism, associated with gonorrhœa or other similar discharge. Most authorities now recognise in the disease a kind of pyæmia, the gonococcus being the essential cause, and the seat of the primary infection being usually the urethra. The third view is perhaps not inconsistent with either of the other two. It represents gonorrhœal rheumatism as a trophic or nutritive disorder, due to reflex disturbance; the urethral inflammation affecting primarily certain centres in the spinal cord and brain, and the altered condition of these giving rise to the articular changes.

According to both the pyæmic and the trophic or reflex theories of gonorrhœal rheumatism, the joint-affection may originate in a purulent discharge from any mucous surface, the urethra included. Thus joint-disease has occasionally been observed in association with dysentery, and with chronic bronchitis. It is beside the purpose of the present article to enter into a discussion of these theories.

Diagnosis.—The diagnosis of this disease turns upon the existence of an urethral discharge in association with articular inflammation. The occurrence of the latter in young male subjects should always rouse the suspicions of the practitioner as to the presence of gonorrhœa; and he ought at once to ascertain, by careful inspection, the state of the urethra, never accepting the patient's statement on the subject. In some instances there may be but a trace of gleet, or the history of a recent gonorrhœa alone may remain. In doubtful cases the urine must be examined with particular care. It should be passed in the presence of the practitioner, and the first fluid ounce of it collected in a separate vessel and examined for products of urethritis that may be washed out, including muco-purulent threads from the prostatic portion of the passage. The previous occurrence of one or more similar attacks in connexion with gonorrhœa will confirm the diagnosis. Ophthalmia in association with subacute articular symptoms ought immediately to suggest the presence of gonorrhœal rheumatism. The suspicion of the gonorrhœal nature of arthritis is sometimes first roused by the failure of salicylates to give relief.

Prognosis.—The prognosis is generally favourable. In young, healthy subjects, under careful treatment, the disease will probably shortly subside. It will, however, prove protracted and obstinate under the opposite circumstances. Unless, also, cure be complete, the future is likely to prove a history of recurrences and accumulating misery. Gonorrhœal rheumatism increases in severity in subsequent attacks, and the prognosis is correspondingly more unfavourable. Another point which should be seriously impressed upon the patient, by way of warning, is that the risk of the recurrence of arthritis also increases with each exposure to gonorrhœal infection.

TREATMENT.—The treatment of gonorrhœal rheumatism is still unsatisfactory. Whilst some practitioners endeavour to check the urethral inflammation as speedily as possible, others strive to encourage the discharge. The former plan is unquestionably the more rational and the more successful. The treatment of the gonorrhœa or gleet must be assiduously persevered with. *See* GONORRHŒA; and GLEET.

At the same time, the attention of the practitioner will be anxiously directed to the joints. If the local symptoms be severe, absolute rest is necessary, the patient being confined to bed, and the affected limb protected by a splint in such a way that applications can be made to the joints. Anodynes may be called for at first, such as poultices, fomentations—simple or opiated, or a liniment composed of equal parts of extract of belladonna and glycerine. In other instances leeches may be tried; blistering in others, where there is either great pain, unrelieved by anodynes, or persistent effusion. In subacute cases with little pain or general disturbance, strapping may be sufficient—particularly with Scott's dressing; and in a more chronic form of the disease friction of the joint and associated parts, and moderate passive and active exercise, may effect a cure.

Internal treatment must be pursued simultaneously. In acute cases free purgation should be obtained at first, and this should be followed by a course of alkaline salines, either alone or in combination with quinine. Treatment specifically directed to the gonorrhœa is often required. If the disease persist, iodide of potassium should be given, combined with alkalis or with iron, according to circumstances; iron alone suits other patients well. Phenacetin and salicylates have appeared beneficial in some instances. In other cases mercurials effect a cure, especially if there be a syphilitic taint, which is not uncommonly the case. The diet must be carefully regulated in the different stages: at first 'low' and without stimulants; afterwards generous. In very chronic cases of gonorrhœal rheumatism, with threatening ankylosis, the patient should be sent, if possible, to a warm watering-place, and be subjected to a thorough course of treatment both externally and internally. Sea voyages very successfully fulfil the different indications for treatment in obstinate cases. *See* RHEUMATIC ARTHRITIS.

J. MITCHELL BRUCE.

RHEUMATISM, Muscular.

—SYNON.: Fr. *Rhumatisme Musculaire*; Ger. *Muskelrheumatismus.*

DEFINITION.—A disorder of fibro-muscular structures, characterised by local pain and spasm, and a certain degree of fever; and generally associated with the rheumatic diathesis.

ÆTIOLOGY.—Muscular rheumatism is most frequently observed in the subjects of the rheumatic diathesis. It occurs in both sexes, and at all ages; children and adolescents being specially liable to rheumatic torticollis, and older subjects to lumbago and chronic muscular rheumatism of the limbs. The exciting causes are chiefly two: first, exposure to cold—above all, exposure of a muscular part to a 'draught' after exertion; and second, sprain or strain of the fibro-muscular structures. A peculiarly obstinate type of the disease has been observed as a sequela of influenza. Muscular pain, tenderness, and spasms are also common in the invasion of acute rheumatism, and in gonorrhœal and chronic articular rheumatism.

ANATOMICAL CHARACTERS. — Nothing is known respecting the anatomical characters of muscular rheumatism, if, indeed, there be any discoverable change in the muscular or fibrous structures.

SYMPTOMS.—The disorder usually commences with slight febrile disturbance, possibly accompanied by sore-throat. Either simultaneously, or in children after one or two days, pain is experienced in the region of some definite muscle or muscular mass, such as the sterno-mastoid or the muscles of the loins; and this speedily becomes so severe as to constitute the leading symptom of the attack. The pain is present only when the affected muscle is thrown into action, so that it may be perfectly relieved by relaxation or rest of the parts involved. The slightest movement, however, from the position of relief is instantly attended with excruciating pain, of a peculiar spasmodic character, which persists until relaxation is again secured. The constant effort to avoid pain gives rise to a feeling and appearance of stiffness, causing the patient to assume characteristic attitudes of the head, trunk, or limbs. Tenderness on grasping the muscle is occasionally well-marked. In some cases several of the joints may also be affected with pain and stiffness.

The constitutional symptoms of muscular rheumatism are generally those of mild fever. The tongue is furred; the appetite is impaired; the bowels are confined; the pulse is somewhat frequent, large, and soft; and there is a feeling of malaise. In other instances these symptoms are extremely slight or altogether wanting, the patient suffering from nothing more than local pain. Occasionally there is catarrhal ophthalmia. Subacute articular rheumatism and sciatica may be present as complications.

Muscular rheumatism usually persists for several days, and gradually declines, but in the milder cases it may last for weeks. One form of the disorder is essentially chronic, the patient suffering for years from pain in various fibro-muscular structures, especially those of the shoulder, arm, thigh and leg, during cold, wet weather.

Varieties.—The following local varieties of muscular rheumatism are recognised by special names:—

1. **Muscular Torticollis.** — Synon.: Acute Wry-neck; 'Stiff-neck'; *Caput Obstipum.*—Here the sterno-mastoid muscle is chiefly involved, but any or all of the cervical muscles may be painful. This form is most frequently observed in young subjects, and is often markedly recurrent. It is easily recognised by the fixed position of the head; and has to be diagnosed from spasmodic torticollis, sterno-mastoid tumour, sprain, tonsillitis, and spinal disease.

2. **Pleurodynia.** — The fibro-muscular structures of the chest-wall are the seat of rheumatism in this variety. Cough is a common exciting cause of the complaint, which is seen chiefly in adults. Pain is complained of in the chest-wall, usually on one side; in some instances it may be excruciating, and of a distressing, spasmodic character. On examination, we find that a particular intercostal space, or the origin of the pectoral or serratus muscles, is the seat of localised tenderness; and that every respiratory act causes lancinating pain in the same situation. The respiratory movements of the affected side are restrained; but the ordinary physical signs of pleural, pulmonary, and cardiac diseases are absent, as are also the *points douloureux* that characterise intercostal neuralgia. If the movements of the corresponding ribs be restrained by plaster or bandage, the pain is effectually controlled. The direct constitutional disturbance is generally not great, unless sleep be prevented by pain.

3. **Lumbago.**—The muscular and fibrous structures of the loins are here the seat of pain, most commonly the erector spinæ, less commonly the latissimus dorsi, or other smaller muscles in the same situation, on one or both sides. As the muscles of the back support the body in the erect position, and participate in the various movements of rising and bending the trunk in all directions, the patient may be compelled to remain at absolute rest in bed. More frequently he is able to move about, although with pain or in a stooping attitude. The amount of febrile disturbance is generally moderate.

Lumbago is easily recognised by the characteristic muscular pain referred to the loins, greatly increased by bending, straightening the back, rising from the sitting posture, or turning in bed; and by tenderness of the muscles on pinching, without the acute defined tenderness on pressure of abscess or neuralgia. At the same time it cannot be insisted upon too strongly, that careful examination of the back, of the abdomen generally, and of the urine, will be required to prevent the practitioner from falling into the not uncommon error of treating cases of serious disease as simple lumbago. Renal calculus, lumbar abscess connected with spinal caries, perinephritis, perityphlitis, abdominal aneurysm, disease of the rectum, uterus, or bladder, spinal meningitis, and small-pox, are the principal morbid conditions which must be borne in mind and excluded in every instance, before the diagnosis is settled. Pain in the loins is also a very common accompaniment of affections of the buttock and lower limbs, such as sciatica, rheumatic affections of the hip-joint, and perhaps lameness from any cause. It is also very frequently met with in gonorrhœal rheumatism.

4. **Dorsodynia.** — Synon.: Omodynia; Scapulodynia.—These names are given to rheumatism involving the structures of the upper part of the back and shoulders. It occurs chiefly in persons much exposed to the weather; and has to be diagnosed chiefly from rheumatism of the shoulder-joint, and certain less common forms of neuralgia connected with the upper dorsal nerves and arms, thoracic aneurysm, and diseases of the cord and spine.

5. **Abdominal rheumatism.** — Muscular rheumatism of the abdominal walls is occasionally observed, either alone or in association with lumbago.

6. **Cephalodynia.** — Muscular rheumatism may affect the scalp, giving rise to a dull, aching kind of headache, on the brow or occiput, aggravated by movement, and occasionally complicated with tenderness of the eyeballs and ophthalmia.

Diagnosis.—Speaking generally, muscular rheumatism has chiefly to be diagnosed from neuralgia, and, as a rule, this can easily be done by the paroxysmal character of the latter, the ætiological relations, and especially the physical signs. A very similar disorder occurs very commonly in gouty subjects. The practical diagnosis of the chief local varieties has already been sufficiently indicated.

Prognosis.—The prognosis of muscular rheumatism is highly favourable. Under careful treatment recovery may be anticipated in a few days or weeks. But the disorder is one which is peculiarly liable to recur on exposure to its exciting causes.

Treatment.—The treatment of muscular rheumatism consists in remedying the constitutional condition; and in relieving the local pain. At the very commencement of the illness, a hot-air or Turkish bath may answer both these indications, and give immediate relief. The first indication will, however, be generally best fulfilled by free purgation, followed by alkaline salines, such as the bicarbonate, citrate, or acetate of potassium, and solution of acetate of ammonium. In more feeble subjects quinine may be given in combination with alkalis; or iodide of potassium in protracted cases. The diet should be of the simplest character.

The best local treatment consists in absolute rest and warmth of the affected parts, which may be variously secured in different instances by confinement to bed, strapping, and plasters. Mustard is one of the most available and successful of remedies. Other counter-irritants or anodynes which give great relief are warm opiate fomentations, or liniments composed of extract of belladonna and glycerine, opium, aconite, chloroform, or camphor, or of various combinations of these. Liniments are more efficacious when sprinkled on the surface of a hot fomentation, firmly applied, than when rubbed into the part. If the suffering be great, a hypodermic injection of morphine and atropine should be given. Belladonna plaster gives at once relief and support in mild cases. The continuous galvanic current occasionally dispels the pain and stiffness almost immediately. A prolonged hot or mustard bath, carefully given, relieves some cases of lumbago. In obstinate cases cupping or blistering may be tried. The affected muscles must be kept warm and carefully protected from cold, especially in torticollis. When rheumatism involves the muscles of the limbs, warm anodyne liniments are the best local measures.

Great care should be exercised to prevent the recurrence of muscular rheumatism, by wearing warm woollen clothing; by avoiding exposure to damp and draughts; by attending to the digestion and the bowels; and by abstaining from severe, sudden, and awkward muscular efforts. In chronic or recurrent cases of the disorder, the patient should, if possible, visit some of the English or foreign baths indicated in the article on RHEUMATIC ARTHRITIS.

J. MITCHELL BRUCE.

RHINITIS (ῥίν, the nose). — Nasal catarrh. *See* NOSE, Diseases of.

RHINOSCOPY (ῥίν, the nose; and σκοπέω, I examine).—SYNON.: Fr. and Ger. *Rhinoscopie.* — The nasal passages can be inspected from the front through the anterior nares, or from the back through the naso-pharynx. The former method is termed 'anterior rhinoscopy,' the latter 'posterior rhinoscopy.' Both methods are necessary for a thorough inspection of the nose.

Anterior Rhinoscopy.—In order to examine the nasal passages from the front, the observer should be seated upright facing the patient. It is always better to employ reflected light, in the same manner as for examination of the larynx (*see* LARYNGOSCOPY). Having concentrated a bright circle of light on the patient's nose, we can obtain a view of the interior of the vestibule by making the patient tilt the head slightly back, and raising the tip of the nose with the thumb. In order to examine the interior of the nasal fossa, a speculum must be used to dilate the cartilaginous aperture. There are several different forms of nasal speculum, but Duplay's bivalve speculum is perhaps the most generally useful. The speculum should be inserted gently with the thumb and forefinger of the left hand, and the blades separated slowly, the patient's head being tilted slightly backwards while this is being done. The anterior end of the inferior turbinated body will first attract attention, forming a rounded prominence projecting from the outer wall. If the patient's head be now tilted a little forwards, the convex surface and lower border of the inferior turbinated body can be traced backwards for a considerable distance, or even for the whole length, presenting usually an irregular wavy outline. The floor of the nasal passage can often be traced to the posterior extremity; and, if a strong light be directed back along the floor, the posterior wall of the pharynx can sometimes be discerned. If the patient's head be thrown backwards, the middle turbinated body will be seen above and behind the inferior. The anterior border, and the angle between this and the inferior, are the parts chiefly seen. Between the middle turbinated body and the septum is a narrow space, known as the olfactory slit, which can only be imperfectly illuminated. When the patient's head is thrown well back, the fore part of the roof will be brought into view, but the superior turbinated body cannot be seen.

The actual extent of the parts seen by anterior rhinoscopy varies much in different cases. A deflected septum is a serious obstacle. Vascular turgescence of the inferior turbinated body, especially at the anterior end, often interferes with the view. This swelling can be reduced by the application of a 5 per cent. solution of the hydrochlorate of cocaine.

Posterior Rhinoscopy.—By this method the posterior nares and naso-pharynx can be inspected. A small mirror, about half or five-eighths of an inch in diameter, is used in the examination. A small laryngeal mirror serves the purpose, but the mirror should be attached to the stem at more nearly a right angle than is usual for laryngoscopy, and it is convenient to have the handle slightly bent to follow the curve of the tongue. A rhinoscope such as Michel's, however, is much more convenient. In this instrument the mirror is in the same plane as the handle, and can be raised to any angle by pressure on a spring.

The patient sits upright, with the head inclined slightly forwards, and is directed to open the mouth and breathe quietly and naturally. The light is concentrated from a reflector on the palate and pharynx, in the same manner as in laryngoscopy. The tongue must generally be depressed with a spatula. One with the handle at right angles to the blade is most convenient. The rhinoscopic mirror, previously warmed, is introduced rapidly, with its reflecting surface upwards, to one or other side of the uvula, close to, but not touching, the wall of the pharynx. By depressing the handle or by pressing on the spring, according to the form of rhinoscope used, the mirror can be made more vertical, and by various movements of the mirror an image of the different parts can be obtained. Difficulties may occur in the examination. The commonest is the drawing up of the uvula and soft palate against the pharyngeal wall as soon as the examination is begun. The patient should be directed to breathe quietly through the nose, and the effort to do this will cause the velum to hang away from the pharyngeal wall. If this do not succeed, the patient should be made to emit the French nasal sound *en*, or *on*. This will often succeed in giving a view of the parts. Painting the throat with a 10 per cent. solution of the hydrochlorate of cocaine will often be an assistance. In certain cases, where the depth of the pharynx is small and the soft palate long, a view can only be obtained by drawing the soft palate and uvula forwards by means of a Voltolini's palate-hook.

Only a limited portion of the post-nasal region is seen reflected in any one position of the mirror. When the mirror is first raised into a nearly vertical position, the posterior surface of the velum is brought into view. By inclining the mirror to a more horizontal position, the septum appears as a sharp, whitish ridge, which serves as a landmark to the parts in this region. On either side of the septum, the ovoid openings of the nasal fossæ, the choanæ, may be brought into view by slightly turning the mirror. Each choana is largely occupied by the posterior ends of the turbinated bodies, the most conspicuous of which is the middle. The inferior is largely hidden by the soft palate, as is also the lower end of the septum. By inclining the mirror to one side, the depression leading to the Eustachian orifice is seen, bounded above and behind by a prominent ridge. By bringing the mirror to a nearly horizontal position, the vault of the naso-pharynx and the region of Luschka's tonsil are brought into view.

JAMES B. BALL.

RHONCHAL FREMITUS.—A physical sign, appreciated by palpation of the chest, elicited by the act of breathing when certain secretions or other materials are present in the larger air-tubes or in a cavity. *See* PHYSICAL EXAMINATION.

RHONCHUS (ῥέγχω, I snore).—Rhonchi are sounds heard on auscultation when the air-channels are partially obstructed. The term is restricted by some authors to the so-called *dry* and more or less musical sounds produced in the bronchial tubes, for instance, *sonorous* and *sibilant* rhonchus; the bubbling and crepitating sounds in chest-disease being spoken of as *râles*. By other authorities, again, all such sounds, whether sibilant or crackling, are described either as *rhonchi* or as *râles*, the terms being interchangeable. *See* PHYSICAL EXAMINATION.

R. DOUGLAS POWELL.

RHYTHM (ῥυθμός, a measured movement).—The relative proportion between the several parts of certain actions. In medical science it is generally applied to the movements of respiration, and to the action of the heart. *See* PHYSICAL EXAMINATION.

RIBS, Diseases of.—*See* CHEST-WALLS, Diseases of; and DEFORMITIES OF THE CHEST.

RICKETS (O. E. *wrikken*, to twist).—SYNON.: *Rachitis*; Fr. *Rhachitisme*; Ger. *Rhachitis*; *Englische Krankheit.*

DEFINITION.—A general disease, affecting the nutrition of the whole body; arresting natural growth and development; perverting and delaying ossification.; retarding dentition; causing the bones to become soft, and to yield to pressure, and the muscles and ligaments to waste; and in many cases producing alteration of the brain, liver, spleen, and lymphatic glands.

ÆTIOLOGY.—Rickets is the consequence of slow impairment of nutrition, and the causes which produce it are principally—bad feeding, foul air, damp cold rooms, want of sunlight, want of exercise, and want of cleanliness. Of these, perhaps the first two have the greatest influence in causing the disease; for if the quantity of nutritive material introduced into the system be restricted by an improper selection of food, and if the oxidation of waste matters be hindered by an insufficient supply of fresh air, interference with nutrition is necessarily carried to a high degree. A pure bracing air will by itself do much in counteracting the effects of an improper dietary, for it has been noticed that injudicious feeding is less hurtful in country places where the air is dry than in large towns. This however, may be partly explained by the greater vigour of the digestive organs in the former case, enabling the child to derive nourishment from food which, under other conditions, would be innutritious. Some children are affected more readily and more severely by these causes than others, for the more the strength of the child is reduced before the actual exciting causes of the disease come into play, the more quickly does the patient fall a victim to their effects. Therefore, all influences which impair the general strength, such as weakness in the parents, or, in the case of the child himself, an attack of acute disease, or even unusually troublesome dentition, must be looked upon as predisposing causes of the disorder. There is no proof that rickets is hereditary. A tuber cular family predisposition renders the occurrence of rickets unlikely. Some years ago a distinguished foreign physician attempted, by arguments drawn chiefly from morbid anatomy, to prove rickets to be invariably a consequence of inherited syphilis. But the reasons for rejecting this hypothesis are overwhelming.

Anatomical Characters.—The bones are affected in three ways: growth is retarded; the spread of ossification into parts still cartilaginous is interfered with; and bone already ossified is softened. The growth of bone is not completely arrested; it rather becomes irregular. There is considerable development of the cartilaginous epiphyses, and also of the fibrous periosteum; but these parts ossify incompletely and slowly; and as the normal increase in size of the medullary cavity continues in the usual way, the bone comes gradually to consist less and less of osseous substance, and more and more of, as yet, unossified matter proliferated at the circumference. It is in this way that the bones become soft, and not from any abnormal absorption of earthy salts from bone already ossified. The process of calcification itself, besides being retarded, is abnormal: it has indeed been described as rather a process of petrifaction than of true ossification. On account of the softness of the long bones, serious deformities ensue, as will be afterwards described. The flat bones become greatly thickened from proliferation of the periosteum. This is especially noticeable at the edges of the cranial bones; and when ossification is completed, the sutures of the skull can be felt to be prominent. In parts, however, and especially in the occipital bone, the osseous substance becomes thinned in places from absorption under the pressure of the growing brain. This condition, which is called 'craniotabes,' can be detected by palpation. Calcification is very slow in the cranial bones, and the fontanelle often remains open long after the end of the second year.

The liver, spleen, lymphatic glands, and kidneys are sometimes enlarged. The increase in size is due, not to the presence of any foreign growth or deposit in these organs, but to irregular hypertrophy of their fibroid and epithelial elements, conjoined with a deficiency in earthy salts—an alteration analogous to the changes in the bones. The brain is enlarged from an increase of the neuroglia, not of the nerve-elements. The voluntary muscles are small, pale, flabby, and soft. Under the microscope their striæ are seen to be indistinct. The urine contains less urea and uric acid than natural, but more phosphates, especially phosphate of lime.

Symptoms.—In most cases the symptoms proper to rickets are preceded by others which indicate a certain amount of interference with the digestive functions. There is occasional vomiting; the bowels are often relaxed; and the motions are habitually loose, pasty-looking, and offensive.

The beginning of the disease is marked by profuse sweating of the head, face, and neck; this is especially seen if the child fall asleep either at night or in the day. Almost at the same time he begins to throw off the bedclothes at night. He will do this even in winter, and may be seen lying almost naked in the coldest weather. Characteristic changes soon occur in the bones. The ends of the long bones enlarge; the flat bones become thickened; and all the bones lose their firmness and grow softer. These changes affect the osseous system as a whole, and lead to serious deformities. If the child had been able to walk, he becomes unsteady on his legs, or even loses the power of walking altogether. He sits or lies about; is drowsy in the daytime; and at night moves his head restlessly from side to side, so as in many cases to wear the hair off the occiput. The flesh is soft and flabby; the motions remain loose and offensive; and the child appears to be occasionally troubled with abdominal discomfort, for he may be found asleep in his cot, resting upon his hands and knees, with his head buried in the pillow. When the bone affection is pronounced the child shows strong dislike to being touched or played with. This wish for quiet is usually ascribed to tenderness, but is more probably occasioned by the knowledge that movement hurries the breathing and raises a demand for air which the chest-wall with its softened ribs is unable to satisfy. If evident tenderness be present, this symptom usually indicates that the case is becoming complicated with scurvy.

A prominent symptom in rickets is the deformity produced by alterations in the shape of the skeleton. The softened ribs yield readily to pressure, and it is to pressure, and not to the force of muscular action, as was at one time supposed, that the distortions are chiefly due. The long bones become bent and twisted. The direction of the bending depends upon the direction in which the force of pressure is applied, and in the lower limbs will therefore manifestly vary according as the child can or cannot walk. Sometimes, however, if the disease begins before the child is able to support himself upon his feet, the lower limbs may escape deformity altogether. They are usually in such cases particularly small and thin, with weak, flabby muscles, but the bones themselves are straight. Force of gravity is another cause of deformity of bone. Thus, in the humerus there is often a curve where the deltoid is inserted; this is produced in great measure by the weight of the hand and forearm when the limb is raised by the deltoid muscle.

The skull is elongated from before backwards; the fontanelle is wide; the sutures are thickened; the forehead is high, square, and sometimes prominent; and the head generally looks large. By palpation of the occiput the condition named 'craniotabes' can sometimes be detected. It is an early symptom. The face appears unduly small when compared with the head, for the growth of the facial bones is arrested. On account of this pause in the development of the jawbones dentition is delayed; but the teeth are not only slow to appear, they are also deficient in dental enamel, so that they are no sooner cut than they begin to decay.

The spine is curved on account of muscular and ligamentous weakness; and if this weakness be great, the natural posterior curve of the spine is so much exaggerated as almost to simulate angular curvature. It disappears, however, at once when the child is lifted up by the shoulders. Sometimes the spine is curved laterally.

The deformity of the chest has the following characters: The softened ribs sink in so as to present a groove passing downwards and outwards on each side of the sternum. The bottom of the groove is formed more by the ribs than the cartilages, so that the enlarged ends of the ribs, looking like a row of beads under the skin, can be seen lying along the outer side of the groove. The sternum is forced forwards by this bending of the ribs, and the antero-posterior diameter of the chest is increased. The deformity is due to the pressure of the external air. In healthy breathing this pressure is overcome by the resistance of the thoracic walls, aided by the force of the inspired air. In the rickety child the resistance offered by the softened ribs is greatly reduced, and they therefore sink in at the parts where they are least supported. On account of the softened state of his ribs, the breathing of a rickety child is quick and laborious.

The pelvis is pressed upon from above by the spine and the abdominal contents, from below by the heads of the thigh-bones; and the direction of these forces varies according to the position of the child. The general shape thus produced is triangular, and the pelvic cavity is often greatly narrowed.

A rickety child is short for his age; for his limbs, besides being bent, are stunted, growth in them being more or less arrested. His joints are large, and loose from relaxation of the ligaments. If the disease be severe, the child gets anæmic and wastes, and the muscles become very flabby and small. His belly is big, even when there is no splenic enlargement, from shallowness of pelvis and flatulent accumulation. Such children give little trouble. They are quiet, and seldom cry if left alone. They are late in walking, late in talking, cut their teeth late, and in nursery phraseology are 'backward children.'

COMPLICATIONS.—One of the chief characteristics of rickets is the *intense sensitiveness to cold* with which it is always accompanied; and it is to chills in different forms that a large proportion of deaths occurring in this disease must be attributed. A catarrh may affect the chest or the belly, and in either case the complication is a very dangerous one.

A pulmonary catarrh in a young child should never be made light of, on account of its tendency to cause collapse of the lung; and if the child be the subject of rickets, the danger is really imminent on account of the softness of the ribs.

If the chill affect the abdomen, as it is very apt to do, an intestinal catarrh is set up; and unless the diarrhœa be quickly arrested, the strength of the child becomes seriously reduced.

Besides its influence in increasing the susceptibility of the body to cold, rickets also heightens the *nervous impressibility* of the child. This effect is not a common result of mere weakness, for in an ordinary case of malnutrition with wasting, the natural sensitiveness of the nervous system to external impressions is impaired. It must be therefore looked upon as a peculiarity of the rickety state. Its effects are seen in the attacks of laryngismus stridulus, tetany, and convulsions to which these children are so liable. Few cases of laryngismus occur in children who are not the subjects of rickets. Such patients usually have carpo-pedal contractions, and are liable to be convulsed upon the very slightest provocation. On account of the backwardness of the teeth in this disease, all nervous derangements are commonly attributed to dentition; but in rickets dentition, although delayed, is not necessarily troublesome; in fact, the teeth, when they appear, are often cut with singular ease.

Another important complication is infantile *scurvy*; indeed, in the child scurvy is rarely seen apart from rickets. It is not that the complaint is due directly to the general impairment of nutrition upon which the rickety state depends, but that owing to the impoverishment of the blood the patient has become peculiarly susceptible to a scurvy diet, and if fed largely upon tinned foods rapidly develops the disease.

The first symptom noticed is a tenderness of the legs. The child, if able to stand, refuses all at once to put his feet to the ground, and cries if required to do so. He shows a great dislike to movement, and as the tenderness increases begins to keep his lower limbs flexed upon his body. He lies quietly in his cot, sometimes moans as if in pain, and screams at the slightest touch. At this time the lower parts of the thighs, the knees, or the legs may be noticed to be swollen, but the colour of the skin is unaltered. The swelling is due to extravasation of blood beneath the periosteum, and, as a rule, is limited to the parts named, but in exceptional cases it may affect the arm, especially about the elbow and wrist. Sometimes there is slight œdema. While these local symptoms continue there is often moderate fever (101°-102° at night); the complexion is pallid, with a faint sallow tint; and the child is very feeble and sweats profusely. There are usually petechiæ and bruise-like patches on the skin, and in some cases the gums are spongy and sore; but this symptom is often absent in the rickety child—indeed, if rickets be marked and dental development arrested, the gums are usually quite healthy. In the worst cases there may be separation of the epiphysis of the affected part of the bone. The child then ceases to flex the limb, and lies with it stretched out as if paralysed.

Under appropriate treatment improvement is rapid. In an ordinary case the more urgent symptoms subside in a few days, and even in bad cases recovery is rarely long delayed. A separated epiphysis under favourable conditions becomes again united with the bone, and the patient quickly regains colour and strength.

Sometimes rickets is accompanied by *chronic hydrocephalus*; the excess of fluid is, however, small. This complication is often suspected where it does not really exist.

Diagnosis.—When the symptoms of rickets are well marked, the bony distortions themselves are sufficiently characteristic to make the nature of the disease unmistakable. It is, however, of great importance to recognise the early symptoms of the disorder, so that by prompt treatment we may prevent the osseous and other changes taking place. It must be remembered that loss of flesh is a late symptom, and that a rickety child is not necessarily a thin one. If an infant pass the ninth month without any appearance of a tooth; if his wrists enlarge; and if on inquiry we find that he is subject to head-sweats at night, and likes to lie naked in his cot, the diagnosis of rickets may be made without hesitation. Weakness of the legs in a young child is often a source of anxiety to parents, and a medical practitioner is consulted because the child is twelve months old and cannot stand. In these cases the early signs of rickets will almost certainly be discovered. Looseness in the joints is common in cases of rickets, where the symptoms of the disease manifest themselves at the end of the second year. The relaxation of the ligaments is not as a rule combined with much bone deformity, although it may be so. Weakness of the legs from rickets is distinguished from essential paralysis by the fact that, although there may be no power of standing, the child is yet able to move his limbs; and that the muscles, although weak, are not powerless.

When scurvy occurs it is important not to misapprehend the nature or gravity of the complication. Early treatment is essential to quick recovery, and delay adds greatly to the child's suffering, if it do not put his life in danger. Marked tenderness in a rickety baby should suggest scurvy at once; and if the child scream loudly, while holding both legs flexed and motionless, our suspicions are amply confirmed. Even if swelling be trifling or absent, gentle manipulation will detect thickening round the shaft of the bone at the seat of tenderness. This is especially likely to be found round the femur for some distance above the knee. In addition, the gums may be spongy, although this symptom is often absent; and there may be petechiæ or bruise-like patches, or even unhealthy sores, on the skin.

Prognosis.—The duration of rickets is dependent upon the duration of the causes which produce it. So long as the unhealthy influences under which the disease originated are in operation, the morbid processes continue; but when a better hygiene is adopted, and failing nutrition is restored, recovery begins.

When recovery takes place, the symptoms gradually become less intense and finally disappear. The enlargement of the joints greatly diminishes, and even the bony distortions become notably reduced, while the bones themselves become thick and strong. Growth, however, is not rapid, and, if the disease have been severe, the child seldom reaches the average height.

When the disease terminates fatally, it is usually through one of the complications which have been mentioned. Sometimes the child sinks and dies, apparently worn out by the intensity of the general disease; but even in these cases the immediate cause of death is usually asphyxia, through the softened state of the ribs. One cause of the great mortality from bronchitis in children is the frequency with which that complaint attacks rickety subjects, even a mild catarrh being seriously dangerous when the ribs are much softened.

In estimating the prospects of recovery in any particular case, we must pay attention to the amount of chest-distortion; and to the presence or absence of disease of the glandular system. If the ribs be much softened, there is always cause for anxiety; and if in a case of pulmonary catarrh there be great recession of the lower ribs in inspiration, the condition is a serious one. The presence of any complication, except perhaps chronic hydrocephalus, necessarily increases the gravity of the case.

Treatment.—As rickets is the direct result of malnutrition produced by the unwholesome conditions in which the child has been living, our first care must be to alter these conditions. We must see that the living rooms are thoroughly ventilated; that the child is taken out regularly into the open air; that he is warmly dressed; and that in his daily bath the washing process is conducted rapidly so as to avoid a chill. We must next select for the patient a diet which is at once sufficiently digestible and nutritious. The term 'digestible' as applied to diet is a relative term. Food digestible to one infant is indigestible to another, and food readily digested by a child in his natural state of health becomes indigestible to him when his stomach is temporarily weakened by teething or any febrile attack. It is not, however, sufficient that the diet should be digestible; it must also be nutritious. Children kept too long at the breast frequently become rickety, even although fed at the same time upon other and suitable food; for the watery breast milk, which forms the principal part of their diet, is sufficient by its bulk to satisfy their desire for food, without supplying the required nourishment to the tissues. Rickety children at the breast should at once be weaned, and, if under twelve months old, should be fed principally upon milk guarded with saccharated solution of lime, in the proportion of fifteen drops to the bottleful. They may take, besides, broths, bread and butter, and occasionally the yolk of an egg lightly boiled or beaten up with milk. Instead of bread and butter, the milk may be thickened for some meals with Chapman's wheat-flour baked in an oven; but farinaceous food should be given with very great caution to these children, on account of their tendency to acid indigestion, which renders a starchy diet particularly likely to disagree. Under twelve months of age the child can seldom bear more than one teaspoonful of a farinaceous powder twice in the day. After the first year, strong beef-gravy, and flower of broccoli stewed, may be added to the diet. At sixteen or eighteen months old, a little mutton may be given, carefully pounded in a warm mortar. A mealy potato, well boiled and mashed, may be allowed, but the effect of all farinaceous food is to be carefully watched. The presence of flatulent pains is a sure sign that the proper quantity has been exceeded. Often in rickets digestive power is very feeble, so that even with the most carefully regulated diet improvement is halting and progress slow. When this is the case, great advantage may be derived from the use of papain as a digestive adjuvant, giving one grain in a spoonful of water with a grain of bicarbonate of sodium immediately before each meal.

The diet and general hygienic arrangements having been regulated, the secondary question of drug-giving has to be considered. Before adopting tonic treatment, it is important to improve the condition of the bowels. A dose of castor-oil or of rhubarb and bicarbonate of sodium should be given to clear away undigested food, and afterwards a few grains of bicarbonate of sodium with a drop of tincture of opium in a little aromatic water will soon remove the offensiveness of the motions. Citrate of iron may then be ordered, and the child should begin at once to take cod-liver oil. The dose of the oil should be small at first (♏ xv–xx), and while it is being taken, the motions should be watched for any appearance of oil in the stools; if this occur, the dose is too large, and must be diminished. As convalescence advances, other medicines may be given; and iron wine, quinine, and reduced iron are all useful. So long as the previous directions have been attended to, the exact tonic used is of comparatively little moment; but cod-liver oil should never be omitted from the treatment. Lime has been strongly recommended by some authors, but according to the writer's experience is of little value unless combined with iron. It may once more be repeated that in rickets the success of treatment is in direct proportion to the conscientiousness with which the rules relative to diet and general management have been carried out; and the mother should be made to understand that the child's recovery depends upon her own watchfulness and care.

The osseous deformities can be prevented to a certain extent, by hindering the child from walking while the bones are still soft. The bowing of the legs is often owing to the child's getting upon his feet before the bones have become sufficiently consolidated to bear the weight of the body. In these cases light well-padded splints which project below the feet will be the best safeguard. When the ligaments of the joints are loose and weak, the joints may be much strengthened by a well-fitting silk elastic support.

After the tenderness of the body has subsided, the child should be well shampooed, especially along the spine, both morning and evening.

With regard to the complications—Diarrhœa and pulmonary catarrh must be treated upon ordinary principles. A good flannel bandage very much diminishes the tendency to relaxation of the bowels, and is of further value in retarding the too rapid descent of the diaphragm, and so in diminishing to a certain extent the recession of the chest-walls during inspiration. The nervous complications are best treated with bromide of potassium. Laryngismus stridulus is often cured at once by bathing the whole body three times a day with water of the temperature of 60° F.

The moment scurvy is detected, the child's diet should be revised. He should be given plenty of fresh cow's milk, and this may be thickened once or twice a day with a well-boiled potato. For medicine, half a grain of quinine dissolved in a teaspoonful of fresh lemon-juice can be given three times a day. If the gums are spongy, Dr. Cheadle's recommendation of the glycerines of tannic acid and carbolic acid (fifteen drops of acid in an ounce of water) is useful, applied with a soft brush. Local attention to the limbs is rarely necessary, but if the epiphyses have separated light splints must be applied.

EUSTACE SMITH.

RIGIDITY (*rigidus*, cold, frozen, stiff). SYNON.: Fr. *Rigidité*; Ger. *Starrheit.*—This term implies the existence of a more or less fixed condition in parts that ought to be freely movable. It is a state met with principally in the limbs, where it is dependent upon certain unnatural conditions of the joints or of the muscles, either separately or in combination. It may, however, occur in the trunk as a whole, or in the neck, owing to the existence of tetanic or tonic spasms in muscles, due to one or other of various causes. The valves of the heart, and the arteries, when stiffened by fibrosis, are said to be rigid. Again, it is a term commonly applied to a condition of the 'os uteri' during parturition, in certain women, in whom the orifice of the womb does not dilate coördinately with the increase in force of the uterine contractions. The term is also sometimes used in connexion with the features. Marked rigidity of a limb at this or that articulation often results from joint-disease. Perhaps more frequently, however, rigidity in a limb is primarily dependent upon altered functional or nutritive conditions of its muscles, which may or may not be associated with actual paralysis implicating the same parts.

Numerous cases exist in which, without the existence of paralysis, or with a comparatively small amount of it, tonic spasms occur in the muscles of a limb, so as to entail rigidity (*see* SPASM). This may be met with, for instance, in hysteria, and in the early stages of some spinal diseases, more especially in primary lateral sclerosis, or in the form of paralysis that goes with Pott's disease.

More frequently still, however, rigidity is found in association with distinct paralysis. For many years a distinction has been made between two kinds of rigidity associated with paralysis; the one of which, known as 'early rigidity,' is apt to supervene soon after the onset of a cerebral or spinal paralytic affection; whilst the other, known as 'late rigidity,' comes on rather in old cases in which mere paralysis with flaccidity of muscles may have been previously present. The former is now believed in many cases to have a tendency to pass into the latter form; and where this becomes well-developed, it is commonly associated with a secondary or with a primary sclerosis of the corresponding lateral column of the spinal cord, even though the initial paralysing lesion may be in some portion of the motor tract of the opposite cerebral hemisphere (*see* SPINAL CORD, Diseases of). In 'early rigidity' we have to do with mere functional changes in the muscles, and the condition itself of rigidity is not constant; it intermits from time to time during the day, and commonly disappears during sleep. But in 'late rigidity,' associated with extensive secondary degenerations in the spinal cord, the nutrition of the nerves, as well as of the muscles and their tendons, appears to suffer, and that, for the most part, in an irretrievable manner. This more severe condition of rigidity is associated with actual shortening of muscles or tendons, and in this stage but little, if any, difference exists between the degree of rigidity of the limbs by night and by day. *See* MOTILITY, Disorders of.

H. CHARLTON BASTIAN.

RIGOR.—SYNON.: Shivering-fit; Fr. *Frisson*; Ger. *Frostanfall.*

SYMPTOMS.—This state is characterised by the following phenomena: There is general shivering, the tremulous movements not infrequently being so great as to cause chattering of the teeth. The face wears an expression of great discomfort, or even of distress. The complexion, especially on the lips and beneath the nails, is blue and livid. The tongue is moist, although thirst is felt. The fingers are shrivelled and 'dead'; the skin is dry and corrugated (*cutis anserina*); and the cutaneous sensibility is diminished. The respiration is quickened and shallow. The pulse is frequent, small, and firm. The temperature of the general surface is raised, although a sensation of cold—sometimes of severe cold—often referred to the back or the abdomen, is present. The extremities, however, as the fingers, ears, and nose, may be colder than natural. With these may be combined other symptoms, such as headache, nausea, vomiting, and the special pains in the back or the limbs which are proper to the different species of fever; but delirium is rarely present.

PATHOLOGY AND ÆTIOLOGY.—Rigors are the result of the disturbance of some, as yet undetermined, nervous tract, which, however, is clearly connected with, if not indeed the same as, the great coördinating centre in the medulla for the respiratory, cardiac, and vascular movements, and which must, further, be in intimate relation with the thermotaxic centre, if such exist. One of the exciting causes of this disturbance may be the existence of some abnormal differences between the temperature of the surface and that of the interior of the body. This suggestion of Liebermeister, at any rate, supplies an answer to one or two perplexing questions. It enables us to understand how it is that a man already in the grasp of a serious disorder, the temperature of whose body is raised, and is rapidly rising, has yet the same sensation of cold as a healthy man whose external temperature is below the normal, and whose nervous and vascular systems are merely reacting in a perfectly natural manner under one of the commonest conditions of animal life, for in each case the surface is colder than the deeper parts, and thus gives rise to a sensation of cold. It gives a plausible solution of the paradox that the greater the absolute heat of the body as a whole, the more acute is the sensation of cold; and it establishes on a scientific basis the empirical belief in the value of rigors as marking the access of disease, when it is seen that their presence is a proof that increased tissue-change, as shown by the increased production of heat—the very essence of fever—has already begun.

The early diagnosis of fevers, whether idiopathic or symptomatic, is often greatly facilitated by the careful study of the phenomena of the initial rigors. Putting on one side the cases in which a local cause may be found to exist, very violent rigors occur chiefly in connexion with the following diseases: Malarial fevers, relapsing fever, variola, scarlet fever, erysipelas, pyæmia, and croupous pneumonia. They are less marked in typhus and enteric fever, pleurisy, catarrhal pneumonia, and bronchitis. It must, however, be remembered that, in appraising the value of any nervous symptom, such as rigors, the personal factor is of extreme importance, and that general rules derived from averages are here more than ever misleading, if applied indiscriminately to individuals.

An additional argument for their central origin is found in the well-known fact, that in children and in persons of unstable nervous equilibrium—for example, epileptics—convulsions are a frequent result of the same causes which produce rigors in other cases.

Rigors occur under the following conditions: (1) In health, when a more or less extensive part of the surface of the body is chilled by external cold. Indeed the chilling of even a very small extent of skin is sufficient to produce them. (2) From irritation of a sensory nerve, and especially in connexion with some mucous surface. Thus rigors are an everyday result of the presence of irritating matters in the stomach or bowels, of catheterism, and of the passage of biliary or renal calculi. (3) With the access or the exacerbation of some local disease, especially if it be one which is to end in the formation of pus. Rigors occur, not only at the beginning, but also during the progress, and with great violence just before the bursting of an abscess. Septic thrombosis in veins is also attended by rigors. The writer himself once experienced very violent rigors in connexion with extensive thrombosis of the veins of the left arm, due to a prick received at a *post-mortem* examination, although no suppuration whatever took place during the whole course of his illness. (4) At the beginning of idiopathic and symptomatic fevers, that is, when the fever has already begun, and the increased heat-production in the viscera has destroyed the natural balance between the temperature of the interior and of the surface of the body.

Although for practical purposes it is convenient to distinguish these different modes of origin of rigors, they are essentially identical; that is, in each we have the effect of irritation of a certain kind conveyed by afferent nerves to some central tract or organ.

TREATMENT.—Warm, mildly stimulating drinks, and external warmth are always grateful to the patient, and perhaps shorten the duration of the attack. Tincture of aconite, in five-minim doses, has the reputation of preventing the occurrence of rigors from local sources of irritation, and may perhaps be useful when they arise from more general or from constitutional causes. Nitrite of amyl also has been employed, apparently with some measure of success. But the only effectual treatment is that of the diseased condition with which they are associated, and this can rarely be begun with advantage before the termination of the rigors or 'cold stage.' Until that period has arrived, it is at best useless to attempt any internal medication; even sulphate of quinine is of little or no avail in this stage of malarial fever, and often seems merely to aggravate the sickness, headache, and general discomfort, which are the usual concomitants of rigors.

J. ANDREW.

RIGOR MORTIS (Lat. The stiffness of death).—SYNON.: Fr. *Rigidité Cadavérique*; Ger. *Todtenstarre.*—The stiffening of the muscles after death, due to coagulation of their plasma. *See* DEATH, Signs of.

RINGWORM.—*See* TINEA TRICOPHYTINA; and EPIPHYTIC SKIN-DISEASES.

RIOLO, in Italy, near Bologna.—Chalybeate, sulphurous saline waters. *See* MINERAL WATERS.

RIPPOLDSAU, in the Black Forest, Germany.—Mixed iron waters. *See* MINERAL WATERS.

RISUS SARDONICUS or SARDONIUS (*risus*, a laugh; and *sardonius*, connected with, or caused by, the herb *sardonia* or *sardoa*, that is, belonging to Sardinia).—A peculiar expression of the face, in which the features are distorted by spasm of the muscles, so as to present the appearance of a painful grin or laugh. It is usually observed in tetanus. *See* TETANUS.

RODENT ULCER.—SYNON.: Fr. *Cancroïde*; Ger. *Epithelialkrebs.*—Rodent ulcer must be recognised as a kind of tumour; but its exact position amongst other forms of new-growth is still not absolutely decided. Hence, in this work a special article is devoted to its consideration. Most authors agree in classing it amongst the epitheliomas; a conclusion which the accumulated evidence of recent years tends to make practically certain.

CLINICAL CHARACTERS. — *Naked-eye appearances.*—A distinguishing feature of most rodent ulcers is the fact that ulceration follows *pari passu* with new-growth, the result being that, as in the case of lupus, instead of the formation of a swelling or tumour, an actual diminution of the size of the part occurs. Another characteristic of the disease is, that while it often makes its appearance at a period of life which might be considered early for an epithelioma, it runs a course of extreme chronicity, and rarely, if ever, affects the lymphatic glands. Many cases last for twenty or thirty years, interfering but little with the general health, and at times in part undergoing a process of feeble cicatrisation. In a case recently observed the cicatrix was rather extensive, and had stood the test of a considerable period of time.

Rodent ulcer begins as a pimple, usually on some part of the face, and most frequently on the side of the nose or about the eye. After this has remained quiescent for a long time, perhaps years, ulceration occurs, and continues to spread with great slowness, involving in its course every structure that it meets. Thus in time huge caverns are excavated in the face; the eyeball may be destroyed; the nose and upper jaw may disappear; and not infrequently, if the disease reach the forehead, the dura mater is exposed, and the brain is seen pulsating at the bottom of the cavity. The appearance of the ulcer is characteristic: the surface is glistening, and is covered with very imperfect granulations; it has an uneven level, and is mottled with yellow and red; the margin is very slightly raised, and somewhat indurated, has a purplish pink colour, and is often considerably undermined. The discharge is thin and purulent. Capillary hæmorrhage not infrequently occurs, but more severe bleeding is rare. A section through the edge shows the narrow margin of new-growth, in which alone the characteristic structure is to be made out. Death may occur from old age or other causes independent of the disease; from an attack of erysipelas or meningitis, or from marasmus induced by the constant worry and discharge.

MICROSCOPICAL APPEARANCES, AND PATHOLOGY. — Many tumours which approach somewhat nearly the condition above described will be found on examination to possess the structure of a lobular epithelioma (*see* CANCER); but the most typical ones will usually exhibit something like the appearance represented in fig. 9, vol. i. Beneath the epidermis, and embedded in a varying amount of stroma consisting of more or less well-developed fibrous tissue, are large, roundish, and irregular masses of densely packed epithelial cells of small size, the circumferential ones taking an oval shape, while the deeper ones are circular. There is, as a rule, no tendency to the formation of globes; but, in some cases which have run a typical course, imperfect nests have been found. The so-called *prickle-cells* are, as far as the writer has observed, never seen. The cells are smaller than those usually met with in an epithelioma, and suggest the origin of the growth from the sweat-glands, a view which is favoured by the fact that the epithelial masses occasionally assume a more or less distinctly tubular arrangement. Strenuous advocates are found in support of, and in opposition to, this theory of the primary source of rodent ulcer, and the same may be said of other hypotheses, such as that it starts from the hair-follicles or the sebaceous glands; but, in default of stronger evidence than is at present forthcoming, it would be unwise to dogmatise upon the question.[1]

PROGNOSIS.—The prognosis in a case of rodent ulcer may be implied from what has been said of its clinical features, course, and terminations.

TREATMENT.—The obvious treatment is free removal by the knife in the early stages. The method of scraping with a sharp spoon, which is not infrequently adopted, is not so likely to reach the limits of the disease, and does not seem to have sufficient theoretical or practical evidence to support it. Mr. Moore was a strong supporter of the plan of removing even very large ulcers; he was in the habit of proceeding with the knife as far as prudence would allow, and applying chloride of zinc paste to any parts it was considered unsafe to cut away. This treatment in his hands and in the hands of other surgeons has been followed by very marked success.

R. J. GODLEE.

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[1] The reader will find some of the literature of the subject in the late Mr. Charles H. Moore's book on Rodent Cancer, in Dr. J. Collins Warren's monograph on Rodent Ulcer, and in the various communications to the *Transactions of the Pathological Society of London*; but in German writings he must search under the head of Epithelial Cancer, to which class rodent ulcer has always been consigned by these authorities.

ROHITSCH, in Styria (Austria).—Acidulated, sulphated waters. *See* Mineral Waters.

ROISDORF, in Germany.—Mixed alkaline table waters. *See* Mineral Waters.

ROME, Central Italy.—Moderately warm, moist, fairly calm winter climate. Mean winter temperature, 45° to 50° F. The air is damper than that of the Riviera. *See* Climate, Treatment of Disease by.

ROMEGNO, in the Val Sugana, in the Austrian Tyrol.—Arsenical sulphate of iron waters. *See* Mineral Waters.

RÖMERBAD, in Styria.—Thermal waters. *See* Mineral Waters.

RONDEBOSCH, in Cape Colony.—*See* Africa, South.

ROSALIA (*rosa*, a rose).—A rose-coloured rash; a term formerly applied to scarlatina and rubeola, before these rashes were clearly differentiated.

ROSEOLA.—Fr. *Roséole*; Ger. *Roseola.* This is a term more used in the past than the present for patchy erythema, in which the tint is less bright than usual, a trivial distinction which scarcely justifies its continued existence. If retained at all, it would be best restricted to the symptomatic eruptions seen in various serious constitutional conditions, such as the early stage of syphilis, in leprosy, and less constantly in variola before the more characteristic rash, and in vaccinia, cholera, diphtheria, malaria, spinal meningitis, and enteric fever.

A so-called idiopathic roseola is sometimes seen in young children, chiefly in the spring and autumn—a disordered alimentary canal, especially during dentition, being the most common ætiological factor.

In such cases there may be an elevation of temperature of several degrees, with other febrile symptoms, but without catarrh, and lasting for a few hours only as a rule. The eruption, which is rosy red, varies much in shape. There may be patches the size of the end of the finger, faint papules, circles, or gyrate outlines. These come out in any part of the body or nearly all over, fading perhaps at one part and appearing at another, the whole process lasting a few days.

Treatment.—But little treatment is required for so transitory an affection, which is chiefly interesting from a diagnostic point of view. Any disorder of the alimentary canal should be corrected by a mild mercurial purge; and every likely cause of irritation, either in the gums or elsewhere, should be searched for and removed if possible.

The roseola symptomatic of the grave disorders enumerated requires no special treatment, the serious constitutional condition claiming the whole attention.

H. Radcliffe Crocker.

ROSE-RASH.—A popular name for roseola. *See* Roseola.

ROTHELN.—The German synonym for rubella; frequently employed by English practitioners. *See* Rubella.

ROUND-WORMS.—*See* Entozoa.

ROYAT, in France.—Muriated alkaline waters. *See* Mineral Waters.

RUBBING SOUND.—A synonym for friction-sound. *See* Physical Examination.

RUBEFACIENTS (*ruber*, red; and *facio*, I make).—A class of counter-irritants which produce simple redness of the skin. *See* Counter-irritants.

RUBELLA (dim. of *Rubeola*).—Synon.: *Rubeola sine Catarrho*; False Measles; German Measles; Epidemic Roseola; Fr. *Rubéole*; Ger. *Rötheln.*

Definition.—A specific eruptive fever. The rash appears on or after the first day of the illness, beginning on the face in rose-red spots, extending next day to the body and limbs; it subsides with the fever on the third day; and is not preceded by catarrh nor followed by desquamation.

Ætiology.—Propagated by contagion, rubella occurs in epidemics, often of limited extent, but with sporadic offshoots. The period of incubation is long, mostly over a fortnight, the extremes being from ten to twenty-one days. Hence a difficulty in tracing the source of personal infection; this is increased by the slight and transient nature of the illness allowing patients to mix freely with others. One attack is preventive of a recurrence, but is not protective against either measles or scarlet fever, nor do attacks of either of these diseases in any way modify the liability to this one; it is as distinct from them as is chicken-pox from small-pox. During epidemics of measles or of scarlet fever, mild and irregular cases of both are not infrequently mistaken for this exanthem; well-marked outbreaks of it are often attributed to measles; while slight attacks of scarlet fever are miscalled Rötheln; and a hybrid disease is imagined which has no existence. Very young infants seem less susceptible than older children; a child at the breast has been known to escape when the mother and other children in the family have been attacked. Adults not infrequently suffer, as many persons escape attacks in childhood; sex makes no difference. The disease is contagious, even before the rash is thrown out; and it continues to be so for some days, or it may be weeks afterwards. Second attacks are rarer than in scarlet fever, but the rule against them may be less absolute than for measles. A recrudescence of the rash from the third to the sixth day is sometimes seen. Rötheln is seldom fatal; when a mortality is reported as high as 3 per cent. of the attacks, measles is present, or scarlet fever.

SYMPTOMS.—Slight fulness of head, heaviness, pain, or giddiness is felt, with aching of the back or limbs, chills, and a little sore-throat, for twelve hours or a day before the rash appears. Very often the rash is first seen with surprise, in dressing, as the feeling of illness has passed or may have escaped notice. Enlargement of the superficial cervical glands is an early sign, most marked in children. There is redness of the fauces and uvula, less mottled than in measles, not so intense as in scarlet fever; the tonsils are full and smooth; there is no ulceration. Sometimes an odour, as in measles, attends the rash. The eyes are suffused, but there is little or no coryza; the lids are somewhat swollen and irritable; the face is flushed, and the cheeks are red or full before the appearance of the spots. These are bright red, raised, rounded, with clear skin between them, but they soon coalesce; not grouped as in measles, the spots are more prominent than in scarlet fever, and there is not the finely diffused redness of the neck and chest observed in that disease. Moreover, the rash is already fading from the face and upper part of the body while extending to the limbs, so that it is less intense on the third day. It leaves some itching, or a very fleeting yellowish tinge, but no discoloured mottling of the skin, and no desquamation. However little illness is felt at the beginning, a rise of temperature commences with, or just before, the rash. It may reach 102°–103°, or be only 2° F. above the normal. With rest in bed this may fall one degree by the end of the second day, but is evenly maintained as the eruption proceeds, and subsides with it on the third day. During the following week it is readily disturbed, either raised by exertion or depressed by fatigue or chill. At this time, eighth to eighteenth day, a relapse has been observed. Here a further caution is required, as convalescents readily take scarlet fever when exposed to that infection; such exposure six days after the rash produced scarlet fever in five days (see p. 161 of Dr. Moore's book on *Fevers*. Dublin, 1892).

Slight catarrhal signs not infrequently come on after the rash has faded. The eyelids are sticky, the nostrils stuffed, the throat sore, or some cough begins. Exposure, or want of care, at this time may determine serious disturbance of health, generally with pulmonary complication.

The urine is often high-coloured in the early part of the illness; the chlorides are increased; but there is no albuminuria, nor has this ever been known to follow. In some few cases transient complaint of the throat or of fatigue has been made a week before the rash; or epistaxis has occurred. Fulness of the small cervical glands is often felt, but no constant intermediate symptoms are found, and any precedent feeling of sickness is without fever.

DIAGNOSIS.—The sudden onset of Rötheln without previous sneezing or cough sufficiently distinguishes it from measles, to which it is much more nearly allied, as well by general characters as by the kind of rash, than to scarlet fever. But the spots are more evenly distributed at wider intervals, each with an areola of its own before coalescence, and not in groups with a common areola. There is no gradual rise of temperature before the rash, nor the sudden fall afterwards, both characteristic of measles. The small lymphatic glands are palpably enlarged in this ailment down the sides of the neck, and perhaps behind the ears, but not specially at the angle of the jaw, as in scarlet fever. The rash appears first in spots on the face. On the second day it may look like that of scarlet fever, or, on the other hand, the red flush of scarlet fever, at first sparsely distributed, or with prominent red papillæ, may lead to mistake; but the sudden onset is much more marked in scarlet fever, when the rash, should it appear as early, is more intense on the third day, especially on the neck and chest, yet without raised papules. Moreover, the fever persists till the fifth day, even when not greatly elevated; there is also the state of the pulse and tongue in scarlet fever, and the prominence of throat-symptoms. Sometimes it is not till the second or third week that desquamation, and possibly signs of renal irritation, or the occurrence of other cases, complete the diagnosis. The length of interval between successive cases is also a distinction. Roseola is not contagious; it occurs in red points or spots, not raised above the healthy skin between; there are no throat-symptoms, no enlarged lymphatic glands, no fever. Erythema affects parts of the skin only: attention restricted to the character of the eruption often leads to error.

PATHOLOGY.—As in most infectious diseases, particles given off from the sick, chiefly by the breath, attach themselves to the mucous surface of the throat or air-passages, and either multiply themselves, or produce a morbid change in the material around them. This morbid matter, entering the lymphatics, is at first arrested in their glands, and thence enters the blood. For a time some of this may be deposited again at the point from which it started, or the amount be too small to produce that arrest of nerve-tone which permits the dilated vessels and increased combustion of general fever. A special effect on the vaso-motor nerves of the skin is necessary to produce the turgidity of the rash, and this not of the momentary character of a passing irritation. Local irritation of the sympathetic in the neck, starting from the mucous membrane, may determine the early appearance of the rash on the face. The skin generally has not the intense vascular injection, with the exudation that results in detached epidermis, as seen in scarlet fever; nor do the congested vessels of the papillæ leave such dilated meshes as after measles. Whether any special microzyme is associated with rubella there is no histological research to show.

Prognosis.—Recovery is so much the rule, that were it not for the mischief any febrile disturbance may excite in weakly children, and the risk of pulmonary disease from premature exposure, all cases of rubella might be expected to do well. In severe cases the throat must be looked to, and in all cases the chest examined. We must bear in mind that infection persists for a month, and that two months may elapse before health is quite restored.

Treatment.—Rest in bed for three days, and confinement to the house for a week, is almost all that is required in rubella. The fever demands no secretion to be increased for its mitigation, nor any special means for its control. Dilute acids may be given for relaxed throat; and tonics, such as bark or iron, during convalescence.

William Squire.

RUBEOLA.—A synonym for measles. *See* Measles.

RUMINATION (*rumino*, I chew again). Synon.: Fr. *Rumination*; Ger. *Wiederkauen*. Rumination, which is the normal method of digestion in a large class of animals, occurs occasionally in the human subject. In the cases recorded, the return of the food usually took place about a quarter of an hour after the meal had been finished. The regurgitation seems to have been produced by the contractions of the muscular coat of the stomach, assisted by those of the diaphragm and abdominal muscles. The food is usually stated to have had no acid taste, and therefore could not have undergone any digestion. Dr. Copland recommends that the meals should be deliberately and carefully masticated. As to medicinal treatment, he had found benefit from ipecacuanha and aloes twice a day, and a tonic draught one hour before dinner.

Samuel Fenwick.

RUPIA (ῥύπος, dirt or filth).—Synon.: Fr. and Ger. *Rupia*.—A term applied to the crusts formed by the desiccation of purulent and ichorous discharge, over the foul sores or ulcers of syphilis.

Description.—The crusts of rupia vary in thickness and extent. Sometimes they are flat and rugged, and sometimes prominent; and they are generally marked on the surface by concentric lines, which indicate the peripheral growth of the ulcers which they conceal. Their colour is grey, sometimes brown, and more or less mottled with black, from admixture of blood with the purulent secretion. When of large size and flat they suggest the idea of an oyster-shell embedded in the skin; at other times they are conical in shape, like the shell of the limpet. This latter variety results from the desiccation of the discharges poured out by a pustule in course of centrifugal growth, and the consequent superaddition of fresh layers to the under-surface of the original crust.

Treatment.—Rupia is chronic syphilis in a state of ulceration, and calls for the treatment applicable to that disease. Iodide of potassium will heal the ulcerations, and then the crusts of rupia will fall off of themselves. If the crusts adhere firmly, it is better to avoid removing them artificially, as they constitute a natural covering to the ulcers whilst the latter remain in existence.

Erasmus Wilson.

RUPTURES (*rumpo*, I break).—Synon.: Fr. *Ruptures*; Ger. *Risse*.—The subject of rupture of organs generally has been discussed in the article on Perforations and Ruptures, to which the reader is referred; and this lesion is dealt with in relation to particular organs where required, as in the case of the heart, stomach, and other important viscera. The general meaning of the word is so evident that it needs no definition. In addition to its obvious meaning, it is used in a popular sense as a synonym for hernia, which is spoken of as a *rupture*. *See* Hernia. Frederick T. Roberts.

S

SACCHORRHŒA (σάκχαρον, sugar; and ῥέω, I flow).—A term applied to the escape of sugar from the body in any of the excretions, or in discharges, such as the urine, sweat, or expectoration. *See* Diabetes Mellitus.

SAIDSCHÜTZ, in Bohemia.—Sulphated bitter waters. *See* Mineral Waters.

ST. ANTHONY'S FIRE.—A popular synonym for erysipelas. *See* Erysipelas.

ST. CATHERINE'S WELLS, in Ontario, Canada.—Iodo-bromated muriated saline waters. *See* MINERAL WATERS.

ST. GALMIER, in Loire, France.—A simple acidulated table-water. *See* MINERAL WATERS.

ST. GERVAIS, in Savoy.—Saline sulphurous waters, thermal and cold. *See* MINERAL WATERS.

ST. HONORÉ, in Nièvre, France. Slightly thermal sulphurous and arsenical waters. *See* MINERAL WATERS.

ST. MORITZ, Upper Engadine, Switzerland. — A bracing mountain winter and summer climate. Baths; whey and milk cure. Altitude, 5,620 feet. *See* CLIMATE, Treatment of Disease by; MINERAL WATERS; and PHTHISIS.

ST. PAUL'S.—A city in Minnesota, on the banks of the Mississippi, 1,200 feet above sea-level. Well protected from winds. Climate cold, clear, dry, and calm; winters rather extreme. Mean annual temperature 44° F.; the mean daily range 19°; rainfall 30 inches. A health-resort for phthisical patients. *See* CLIMATE, Treatment of Disease by.

ST. SAUVEUR, in the French Pyrenees.—Sulphur waters, slightly thermal. *See* MINERAL WATERS.

ST. VITUS'S DANCE.—A popular synonym for chorea. *See* CHOREA.

SALINS, near Dôle, in France.—*See* MINERAL WATERS.

SALINS-MONTIER, in Savoy.—Muriated saline waters, with some iron, iodine, and arsenic. *See* MINERAL WATERS.

SALIVARY CALCULUS. — *See* MOUTH, Diseases of.

SALIVARY FISTULA.—*See* MOUTH, Diseases of.

SALIVARY GLANDS, Diseases of. SYNON.: Fr. *Maladies des Glandes Salivaires*; Ger. *Krankheiten der Speicheldrüsen.*

SUMMARY.—These glands, as well as their ducts, are liable to be attacked by inflammation; the latter may also become mechanically occluded. The parotid gland is the seat of the disorder known by the name of *Cynanche parotidea*, or mumps (*see* MUMPS). *Salivary calculus* and *salivary fistula*, as well as *ranula*, are described in the article MOUTH, Diseases of. Occasionally the parotid is sympathetically invaded by inflammation during the height of, or at the termination of, other acute diseases, and this affection requires special consideration here.

Metastatic or Symptomatic Parotitis.—This affection is met with during the course of, or convalescence from, several of the acute eruptive fevers, such as typhus and typhoid fevers, scarlet fever, small-pox, and measles. It commences, according to the researches of Virchow, with congestion of the gland, followed by the usual result. Soon thereafter the duct becomes affected; and there is found in it a tough, filamentous, whitish substance, which speedily is transformed into pus. This invades the lobules of the gland; these then soften and break down, until the whole of the gland-tissue is more or less destroyed, as well as the interstitial tissue, by phlegmonous inflammation. Sometimes, however, only the gland-tissue proper is destroyed, and the gland, when examined *post mortem*, appears as if studded with numerous suppurating islands. This phlegmonous inflammation spreads from its seat of origin in various directions, most frequently to the neighbouring connective tissue enveloping the muscles found in this situation, descending to the clavicle, not sparing the periosteum and bones; and it has even been known to pass to the brain and its coverings.

SYMPTOMS.—If this affection develop itself during the height of an acute disease, then, by reason of the stupefying effect of the primary disease, the more manifest subjective symptoms are wanting, and the complaint is consequently said, somewhat improperly, to come on insidiously. But careful observation will reveal, by the unusual rise in temperature, the increased restlessness, and the somewhat distressed look of the patient, that some new complication is about to discover itself, and will warn the intelligent practitioner to make a close physical examination of the various organs. Probably the first indication of this metastatic parotitis will be a little swelling about the lobe of the ear, and closer investigation will show loss of the usual depression between the lower jaw and the mastoid process, and in its place a more or less hard tumour Pressure will usually elicit an expression of pain from even an apathetic patient. The inflammation may end either in resolution or in suppuration. The former termination may be looked for if the enlargement have formed slowly, and during the convalescence of the individual from the original disease. Suppuration is, in all cases, to be dreaded; and this is indicated by the irregularly reddened appearance of the swelling, and ultimately the sense of fluctuation. Occasionally the pus finds its way outwards, or discharges through the external auditory meatus, this latter being by no means an uncommon method of exit; or the pus burrows about in the cellular tissue investing the various muscles in this region.

PROGNOSIS.—This depends greatly on the

severity of, and the stage of, the primary disease during which this complication declares itself. If it make its appearance at the height of the fever, and particularly if that be a grave form of fever, then the prognosis must be very guarded. Trousseau remarks that it is an affection from which he has almost never seen enteric or other fever patients recover. This is certainly not in accord with the experience of this country. If it occur during convalescence from a fever or other disease, the prognosis is then much more favourable.

Treatment.—Warm poultices must be applied from the first; supporting measures used; and the patient's powers sustained by plentiful nourishment, and the exhibition of stimulants and tonics. If there be any tendency to suppuration, the poulticing must be diligently maintained, and an opening made into the abscess the moment that fluctuation is certainly made out. Caution must be exercised in this case, for, if no pus be evacuated, the incision not only is useless, but rather increases the œdema of the tissues, besides putting the already weakened patient to unnecessary pain.

Enlargement of the Parotid Gland. This may be either benign or malignant. In the former case it is usually the result of a previous parotitis, or it may be due to the development of some tumour in the body of the gland. Such cases are distinguished from the malignant variety by the fact that the skin always remains freely movable over the tumour, and over the lower jaw; while in the malignant affection the lower jaw is with difficulty defined, and is not readily moved. The tumour is always limited to one side; and the malignant growth rarely has its starting-point in this gland, similar disease being found in other organs. The simple tumour may be modified, if not altogether removed, by the external and internal use of iodine long continued; failing this, operation is called for. The malignant variety calls for surgical treatment.

Claud Muirhead.

SALIVATION. — Synon.: Ptyalism; Fr. *Salivation*; Ger. *Speichelfluss.*—Increased flow of saliva can only be styled a disease when the amount secreted exceeds that which in health passes into the stomach. Strictly speaking, ptyalism is not a distinct disease, any more than dropsy can be so accounted, but it obtains a position as an independent disorder in the nomenclature of diseases, and must therefore be shortly noticed.

Ætiology.—The causes which give rise to salivation are numerous, as are also the diseases of which it is a symptom. Thus any irritation of the mucous membrane of the mouth and fauces at once induces an increased flow of saliva. Hence this is one of the leading symptoms of aphthæ, thrush, cancrum oris, ulcers, and excoriations of the mouth and tongue, scorbutic and syphilitic affections of the mouth, glossitis, mumps, and various affections of the fauces and pharynx. This salivation may also be a reflex effect, as when it occurs in cases of tic, facial neuralgia, pregnancy, or gastric affections. Ptyalism is also the result of the ingestion of certain drugs, mineral and vegetable, as in the case of the prolonged use of mercury, iodine, and jaborandi. These seem to produce an alteration in the character of the saliva, as well as in the quantity. An increased or diminished flow of saliva is also induced by direct nervous agency, as when mental emotions, such as fear, suddenly render the mouth parched and dry; and the opposite effect is induced by the thought of palatable articles of food, and then the mouth is said to 'water.' In various conditions the saliva dribbles away, as in the insane, in paralytic persons, in those stupefied by disease, such as typhus, and in teething children.

Symptoms.—The symptoms of salivation are evident enough. The individual complains of no pain, but of the exceeding discomfort in the constant spitting and gathering of saliva in the mouth, which interrupts speech, deglutition, and sleep. If it continue unchecked for some time the patient emaciates. When the affection is due to mercury, the first evidence of the constitutional action of the drug, which precedes the salivation, is a peculiar taste in the mouth, of a 'coppery' nature, with tenderness of the gums of the upper jaw, and fœtid odour of the breath; then there are observed salivation, large flabby tongue, and, if it goes still farther, ulceration of the gums and mouth.

Treatment.—When salivation is due to some nervous cause, or if the cause be not very apparent, ten-drop doses of tincture of belladonna thrice daily are often sufficient to put an end to it in one or two days. Minute doses of nitrate of pilocarpine, gr. $\frac{1}{36}$, have also proved useful. If it be induced by mercury or other drug, the use of this must be entirely suspended. Mild astringent mouthwashes should be ordered, such as chlorate of potassium, alum, or acetate of lead in solution, to be used frequently.

Claud Muirhead.

SALZBRUNN, in German Silesia. Alkaline waters. *See* Mineral Waters.

SALZKAMMERGUT, in Austria. An inland bracing summer climate. *See* Climate, Treatment of Disease by; and Ischl.

SALZUNGEN, in Saxe-Meiningen. Cold muriated saline waters. *See* Mineral Waters.

SAN DIEGO.—A health-resort in South California, on the Pacific Coast. A dry bracing climate, resembling that of Santa Barbara, free from fog, and equable. Mean temperature 60° F.; the records seldom rise to 80° or sink to the freezing-point. Mean daily range only 15°. Average rainfall 10 inches. Winds principally from the north-west. Well suited for pulmonary complaints. *See* CLIMATE, Treatment of Disease by.

SANDOWN, in the Isle of Wight. Exposure S.E. Mean temperature 51·4°. An open, bright, bracing health-resort, with good sea-bathing. *See* CLIMATE, Treatment of Disease by; and SEA-AIR and SEA-BATHS.

SAND-WORM. — A term sometimes employed to designate the sand-flea or jigger. *See* CHIGOE.

SANGUINEOUS (*sanguis*, blood).—This word is used in relation to the presence of blood in discharges, effusions, or extravasations, when they consist more or less of this fluid, as in hæmoptysis, hæmorrhagic pleurisy, and cerebral hæmorrhage.

SANITARY LAW.—The first laws which were passed in England relating to sanitary matters were directed successively against the scourges plague, small-pox, and cholera, and these were placed under control by various statutes which were passed between 1603 and the commencement of the reign of Victoria.

The statute of 1 Jac. I. c. 31 made it a capital offence for any person having an infectious sore upon him uncured to go abroad and converse in company, after being commanded by the proper authority to keep his house. That Act was repealed in the first year of the present reign, but some statutes relating to quarantine, which were passed in the first instance for the purpose of dealing with plague, remain in force to the present day. Small-pox was not the subject of legislation until a generation after the discovery of vaccination, and the first Act dealing with it was passed in 1840 (*see* VACCINATION). Cholera became the subject of legislation in 1832, after the serious visitation with which the country had then been afflicted. By the law that was then passed the Privy Council were empowered to issue such orders as appeared expedient for the purpose of preventing the spread of the epidemic, for securing the proper burial of the dead, and for relieving the necessities of persons suffering from the malady. Apart from epidemic disease, the Legislature was slow to deal with sanitary precautions, and it was left to private persons to vindicate the public right to have nuisances abated by the enforcement of the common law. This procedure was tedious, costly, and uncertain, and hence, in boroughs and populous towns, special local statutory powers were frequently obtained.

Boards of commissioners for the paving, improvement, lighting, and watching of towns were formed for many places under the sanction of Parliament, and these bodies, together with the reformed municipalities created by the Municipal Corporations Act of 1835, formed the nucleus around which developed the local governing bodies as we know them to-day. The first conception of a local authority was that of a body whose existence, except in the case of a corporation created by charter, could only be brought about by the direct sanction of Parliament given by way of a local Act. This procedure, though at first cumbersome, was, under the Ministry of Sir Robert Peel, greatly simplified by the passing of what have been long known as the Model Clauses Acts. The effect of this improvement was to enable comparatively short local Acts to be passed, and to incorporate by mere reference a large number of useful provisions relating to various matters of sanitary and other local administration. Owing, however, to the costliness of obtaining parliamentary sanction to local bills, there was a growing demand for some simpler method of creating a local governing body in a town of sufficient importance to require one; and the sanitary commissioners who had been examining the condition of the country having reported as to the great need for the establishment of a general scheme of local government for towns and populous districts, the attention of Parliament was at length seriously directed to the matter. After two unsuccessful attempts the Public Health Act of 1848 was passed. By this epoch-marking statute a general board of health was established, and power was given to it to cause the Act to be applied to any place having a known and defined boundary. These provisions were taken advantage of freely, and the regulation of such matters as the laying out and sewerage of streets, the construction and drainage of houses, the provision of a water-supply to towns, and the removal of nuisances, were put within the easy reach of towns that had previously been subject to no control whatever. Ten years later this Act was repealed and replaced by the Local Government Act, 1858. This Act remained in force till 1875, and under it about eight hundred local boards were formed up to 1872. As a result of the report of the Sanitary Commission of 1869, the scheme of local government was carried still further by the passing of the Public Health Act, 1872, under which the whole country was divided into urban and rural sanitary districts, and the Sanitary Acts applied to the entire country. And when the Public Health Act, 1875, which repealed and consolidated all the previous statutes outside the metropolis that related to sanitary law, was passed, this arrangement was not disturbed, and it now forms the basis of local government as settled by the Local Government Act, 1894. On January 1, 1894, there were in existence 1,030 urban sanitary authorities and 574 rural sanitary authorities, and under the Act mentioned these bodies are continued in force, under the description of urban district councils and rural district councils, for urban districts and rural districts respectively. Of the urban districts, 64 were county boroughs, 238 were non-county boroughs, 31 were Improvement Act districts, and 697 were Local Government districts formed under the Public Health Acts.

In addition to these bodies, every rural parish having a population of three hundred or upwards will have a parish council; and such rural parishes as have a population of one hundred or upwards will be enabled to have a parish council if they so resolve. Some parishes may by order of the county council be grouped under a common parish council. In addition to these bodies, there is in rural districts the parish meeting for every 'rural parish' in such district. This consists of the persons known as the parochial electors—that is, the persons who are registered on the parliamentary and local government register of electors—for the parish. Taking them in order of importance, there are the following local governing bodies: (1) Councils for counties; (2) Councils for municipal boroughs; (3) Councils for urban districts which are not boroughs; and (4) Councils for rural districts. For the purposes of sanitary administration the urban and rural district councils are the most important bodies, and the jurisdiction of the county councils over them is very limited. In some cases, such as the provision of sewerage and water-supply, a parish council has the right to complain to the county council that the rural district council is in default, and the county council can thereupon supersede that body. In the case of urban district councils in default an appeal lies to the Local Government Board.

It is unnecessary here to set forth the mode of election and qualifications of councillors or the details of the constitution of the councils; but it may be stated in general terms that the councils consist of members who are called councillors, and who are elected by the registered electors, and, in the case of municipal corporations and county councils, with the addition of aldermen who are elected by the councillors. The constitution of county councils is determined by the Local Government Act, 1888, of municipal corporations by the Municipal Corporations Act, 1882, and of urban and rural district councils by the Local Government Act, 1894.

It will now be necessary to describe in detail the powers of the local authorities, and the rights and liabilities of individuals in England and Wales, with special reference to sanitary matters only.

POWERS OF LOCAL AUTHORITIES.—A. *County Councils.*—By the Local Government Act, 1888 (section 17), it is provided that a county council may appoint one or more medical officers of health, and may make arrangements for rendering the services of any such officer regularly available in the district of any district council; and section 19 further provides that if it appears to a county council from the report of the medical officer of health of any district that the Public Health Act, 1875, has not been properly put in force within the district to which the report relates, or that any other matter affecting the public health of the district requires to be remedied, the council may cause a representation to be made to the Local Government Board on the matter. Such a representation would enable that Board to put in force the powers conferred upon them by section 299 of the Public Health Act, 1875. Under that section they may issue an order limiting the time for the local authority to perform its duty; and if such duty is not performed by the time so limited, the order may be enforced by writ of *mandamus*, or the Board may appoint some person to perform such duty.

B. *Urban and Rural District Councils.*—It is declared by section 7 of the Housing of the Working Classes Act, 1885, to be the duty of every local authority entrusted with the execution of laws relating to public health and local government to put in force from time to time, as occasion may arise, the powers with which they are invested, so as to secure the proper sanitary condition of all premises. These and other powers possessed by urban authorities under the sanitary laws will now be explained. They may be roughly divided into powers (1) which relate to the improvement of the general sanitary condition of the district viewed in its physical aspects; (2) which relate to the maintenance of dwellings and their surroundings, as well as factories and workshops, in a proper sanitary condition. It must be borne in mind that the powers here described are those exercisable by urban authorities, and that the powers of rural authorities, though capable of being extended, as occasion arises, by means of orders issued by the Local Government Board, are under the Public Health Acts limited to certain matters only.

1. *Powers which relate to the improvement of the general sanitary condition of the district.*

Sewerage.—Foremost under this heading comes the provision of sewers, and these the local authority is required to make so far as may be necessary for effectually draining their district. Thus the surface-water and the sewage will be carried off, but it must not be discharged into any stream until it has been purified. Sewage may be disposed of or dealt with by any suitable method, and sewage works can be provided for the purpose, either in or out of the district of the local authority. One local authority may agree for the communication of their sewers with those of another in an adjoining district.

Water-Supply.—A local authority may provide their district or any part of it with a supply of water proper and sufficient for public and private purposes, and may (1) construct and maintain waterworks, dig wells, and do any other necessary acts; (2) take on lease or hire any waterworks, and (with the sanction of the Local Government Board) purchase any waterworks, or any water or right to take or convey water, either within or without their district, and any rights, powers, and privileges of any water company; and (3) contract with any person for a supply of water.

Before commencing to construct waterworks within the limits of supply of any water company empowered by Act of Parliament or any order confirmed by Parliament to supply water, the local authority must give written notice to every water company within whose limits of supply the local authority are desirous of supplying water, stating the purposes for which and (as far as may be practicable) the extent to which water is required by the local authority.

It is not lawful for the local authority to construct any waterworks within such limits if and so long as any such company is able and willing to supply water proper and sufficient for all reasonable purposes for which it is required by the local authority; and any difference as to whether the water which any such company are able and willing to lay on is proper and sufficient for the purposes for which it is required, or whether the purposes for which it is required are reasonable, or as to the charges, must be settled by arbitration.

The provisions of the Waterworks Clauses Acts with regard to communication pipes, the waste or misuse of water, the fouling of water, and the payment and recovery of water-rates, are incorporated with the Public Health Act, 1875, and in this way local authorities are enabled to take advantage of the powers which are generally conferred on water companies for carrying out the supply of water to any district.

Pollution of Rivers.—Any local authority, with the sanction of the Attorney-General, may, either in their own name or in the name of any other person, with the consent of such person, take proceedings under the Public Health Act for the purpose of protecting any watercourse within their jurisdiction from pollutions arising from sewage, either within or without their district. Besides these powers, the Rivers Pollution Prevention Acts require local authorities to enforce a number of penal provisions which are designed to prevent the fouling of streams by solid matters, by sewage, or by manufacturing or mining refuse.

Polluted Wells.—Under the Public Health Act, 1875, it is provided that, on the representation of any person to any local authority that within their district the water in any well, tank, or cistern, public or private, or supplied from any public pump, and used or likely to be used by man for drinking or domestic purposes, or for manufacturing drinks for the use of man, is so polluted as to be injurious to health, such authority may apply to a court of summary jurisdiction for an order to remedy the same; and thereupon such court shall summon the owner or occupier of the premises to which the well, tank, or cistern belongs if it be private, and in the case of a public well, tank, cistern, or pump, any person alleged in the application to be interested in the same, and may either dismiss the application, or may make an order directing the well, tank, cistern, or pump to be permanently or temporarily closed, or the water to be used for certain purposes only, or such other order as may appear to them to be requisite to prevent injury to the health of persons drinking the water. The court may, if they see fit, cause the water complained of to be analysed at the cost of the local authority applying to them under this section.

Streets.—All streets which are highways repairable at the expense of the inhabitants, and the pavements, stones, and other materials provided for the purposes of the highways by any surveyor of highways, belong to the local authority, and are under their management and control. They must level, pave, flag, channel, alter, and repair the streets as occasion may require, and may raise, lower, or alter the soil, and may place and keep in repair fences and posts for the safety of foot passengers. They may regulate the line of buildings in streets by reference to existing buildings, but they cannot prescribe a building-line. They may make by-laws as to the width and construction of new streets. The local authority can undertake or contract for the proper cleansing of streets, the removal of house refuse from premises, and the cleansing of earth-closets, privies, ashpits, and cesspools, and may by public notice require the periodical removal of manure or other refuse matter from stables or other premises.

Cemeteries.—Under the Public Health (Interments) Act, 1879, a local authority may provide a cemetery, and the provisions of the Cemeteries Clauses Act, 1847, are made applicable. Where the Burial Acts are in force, burial grounds may be provided by the local authorities who exercise the functions of a burial board, or by a specially appointed burial board itself.

Pleasure - Grounds. — An important power, the exercise of which must have a very important bearing on the general well-being of our towns, is that which enables a local authority to provide pleasure-grounds for its district. A local authority can provide and maintain public walks and pleasure-grounds and other open spaces by the exercise of the powers conferred by the Public Health Acts and the Open Spaces Acts.

2. *Powers which relate to the maintenance of dwellings and their surroundings, as well as factories and workshops, in a proper sanitary condition.*

Construction of Buildings. — The Public Health Acts contain many important provisions relating to the sanitary condition of dwelling-houses, but the most important are those which authorise the making of by-laws for regulating the erection of new buildings, as defects may be prevented at the outset that could not be remedied at a later stage. This by-law-making power extends to enable the local authority to require plans of every new building, to regulate the thickness of walls, and the provision of damp-proof courses, to require the site under the floors to be covered with concrete, to regulate the height of rooms, to prescribe definite areas of open space in front and rear so as to secure a free circulation of air, to require that drains shall be properly laid and ventilated, to regulate the mode of construction of water-closets, privies, ashpits, and cesspools, and their distance from dwellings and sources of water-supply, as well as many other matters. The powers are contained in section 157 of the Act of 1875, as amended by section 23 of the Act of 1890, which latter Act is only in force in the districts which adopt it. These sections are as follows: The Public Health Act, 1875, section 157, provides, as regards buildings, that every urban authority may make by-laws with respect to the following matters—that is to say: With respect to the structure of walls, foundations, roofs, and chimneys of new buildings, for securing stability and the prevention of fires, and for purposes of health; With respect to the sufficiency of the space about buildings, to secure a free circulation of air, and with respect to the ventilation of buildings; With respect to the drainage of buildings, to water-closets, earth-closets, privies, ashpits, and cesspools in connexion with buildings, and to the closing of buildings or parts of buildings unfit for human habitation, and to prohibition of their use for such habitation.

And the Public Health Acts (Amendment) Act, 1890, section 23, provides that the above-cited section shall be extended so as to empower every urban authority to make by-laws with respect to the following matters—that is to say: The keeping water-closets supplied with sufficient water for flushing; the structure of floors, hearths, and staircases, and the height of rooms intended to be used for human habitation; and the paving of yards and open spaces in connexion with dwelling-houses.

By section 23 of the Act of 1890, it is further provided as follows: 'Every local authority may make by-laws to prevent buildings which have been erected in accordance with by-laws made under the Public Health Acts from being altered in such a way that if at first so constructed they would have contravened the by-laws.' All by-laws made under these enactments require to be confirmed by the Local Government Board, but before such confirmation can be obtained notice of intention to apply for confirmation must be given, in one or more of the local newspapers circulated within the district to which the by-laws relate, one month at least before the making of the application; and for one month at least before the application, a copy of the proposed by-laws must be kept at the office of the sanitary authority, and must be open during office hours thereat for the inspection of the ratepayers of the district to which the by-laws relate, without fee or reward. When such by-laws have been made, it is the duty of the local authority to enforce them against everyone with impartiality.

Drainage.—It is not lawful in any urban district newly to erect any house or to rebuild any house which has been pulled down to or below the ground floor, or to occupy any house so newly erected or rebuilt, unless and until a covered drain or drains be constructed, of such size and materials, and at such level, and with such fall as, on the report of the surveyor, may appear to the urban authority to be necessary for the effectual drainage of such house; and the drain or drains so to be constructed must empty into a sewer which the urban authority are entitled to use, and which is within one hundred feet of some part of the site of the house to be built or rebuilt; but if no such means of drainage are within that distance, then into such covered cesspool or other place, not being under any house, as the urban authority direct.

Cleansing.—Where, on the certificate of the medical officer of health or of any two medical practitioners, it appears to any local authority that any house or part thereof is in such a filthy or unwholesome condition that the health of any person is affected or endangered thereby, or that the whitewashing, cleansing, or purifying of any house or part thereof would tend to prevent or check infectious disease, the local authority are required to give notice in writing to the owner or occupier of such house or part thereof to whitewash, cleanse, or purify the same, as the case may require.

Water-Supply.—Where on the report

of the surveyor of a local authority it appears to such authority that any house within their district is without a proper supply of water, and that such a supply of water can be furnished thereto at a cost not exceeding the water-rate authorised by any local Act in force within the district, or where there is not any local Act so in force, at a cost not exceeding twopence a week, or at such other cost as the Local Government Board may, on the application of the local authority, determine under all the circumstances of the case to be reasonable, the local authority may give notice in writing to the owner, requiring him, within a time therein specified, to obtain such supply, and to do all such works as may be necessary for that purpose. If such notice is not complied with within the time specified, the local authority may, if they think fit, do such works and obtain such supply, and for that purpose may enter into any contract with any water company supplying water within their district; and water-rates may be made and levied on the premises by the authority or company which furnishes the supply, and may be recovered as if the owner or occupier of the premises had demanded a supply of water and were willing to pay water-rates for the same.

Particular Classes of Dwellings.—In regard to particular classes of dwellings, there are special provisions in the Public Health Acts. Such provisions relate to cellar dwellings, common lodging-houses, and houses let in lodgings or occupied by members of more than one family. As to the first, it is provided that it shall not be lawful to let or occupy or suffer to be occupied separately as a dwelling any cellar (including for the purposes of the Act in that expression any vault or underground room) built or rebuilt after the passing of the Act (viz. August 11, 1875), or which was not lawfully so let or occupied at the time of the passing of the Act. But cellar dwellings which were then in actual occupation are allowed to be used subject to certain limitations as to height and situation.

A person may not keep a common lodging-house or receive a lodger therein unless the house is registered in accordance with the provisions of the Act, nor unless his name as the keeper thereof is entered in the register kept under the Act; but when the person so registered dies, his widow or any member of his family may keep the house as a common lodging-house for not more than four weeks after his death without being registered as the keeper thereof.

A house may not be registered as a common lodging-house until it has been inspected and approved for the purpose by some officer of the local authority; and the local authority may refuse to register as the keeper of a common lodging-house a person who does not produce to the local authority a certificate of character, in such form as the local authority direct, signed by three inhabitant householders of the parish, respectively rated to the relief of the poor of the parish within which the lodging-house is situate for property of the yearly rateable value of six pounds or upwards.

The most effective control that can be exercised over common lodging-houses is that obtained by means of by-laws which every local authority is required to make: (1) for fixing and from time to time varying the number of lodgers who may be received into a common lodging-house, and for the separation of the sexes therein; and (2) for promoting cleanliness and ventilation in such houses; and (3) for the giving of notices and the taking precautions in the case of any infectious disease; and (4) generally for the well ordering of such houses.

As regards houses let in lodgings which are not common lodging-houses, but are commonly known as lodging-houses or tenement houses, the only special control that can be exercised is by means of by-laws under section 90 of the Public Health Act, 1875. This section is put in force in the district of every local authority by section 8 of the Housing of the Working Classes Act, 1885, and its provisions are very much the same as those of the section relating to by-laws for common lodging-houses.

Conditions to be Implied on Letting Houses for the Working Classes.—It is provided by section 12 of the Housing of the Working Classes Act, 1885, that in any contract for letting for habitation by persons of the working classes a house or part of a house, there shall be implied a condition that the house is at the commencement of the holding in all respects reasonably fit for human habitation. The expression 'letting for habitation by persons of the working classes' means the letting for habitation of a house or part of a house at a rent not exceeding in England the sum named as the limit for the composition of rates by section 3 of the Poor Rate Assessment and Collection Act, 1869.

Nuisances.—Coming now to general nuisances, we find that section 91 of the Public Health Act, 1875, as amended by section 9 of the Housing of the Working Classes Act, 1885, and by the Factory and Workshops Acts, 1878 to 1891, sets out a comprehensive list of nuisances which are capable of being abated, and for the abatement of which the local authority is empowered to serve notices, and on the non-compliance with the terms thereof to apply to a court of summary jurisdiction for an order requiring the abatement of the nuisance, or prohibiting its recurrence, and directing the execution of any works necessary to secure that end. The nuisances which are liable to be dealt with in this way are set out as follows:—

(1) Any premises (including a tent, van,

shed, or similar structure used for human habitation) in such a state as to be a nuisance or injurious to health.

(2) Any pool, ditch, gutter, watercourse, privy, urinal, cesspool, drain, or ashpit, so foul or in such a state as to be a nuisance or injurious to health.

(3) Any animal so kept as to be a nuisance or injurious to health.

(4) Any accumulation or deposit which is a nuisance or injurious to health.

(5) Any house or part of a house or a tent, van, shed, or similar structure used for human habitation, so overcrowded as to be dangerous or injurious to the health of the inmates, whether or not members of the same family.

(6) Any factory, workshop, or workplace not kept in a cleanly state, or not ventilated in such a manner as to render harmless as far as practicable any gases, vapours, dust, or other impurities generated in the course of the work carried on therein that are a nuisance or injurious to health, or so overcrowded while work is carried on as to be dangerous or injurious to the health of those employed therein.

(7) Any fireplace or furnace which does not as far as practicable consume the smoke arising from the combustible used therein, and which is used for working engines by steam, or in any mill, factory, dyehouse, brewery, bakehouse, or gaswork, or in any manufacturing or trade process whatsoever; and

Any chimney (not being the chimney of a private dwelling-house) sending forth black smoke in such quantity as to be a nuisance.

Since the Factory and Workshop Act, 1891, the duty of enforcing the sanitary provisions of the law in the case of all factories and workshops is vested in local authorities.

The local authority, or any of their officers, must be admitted into any premises for the purpose of examining as to the existence of any nuisance thereon, or of enforcing the provisions of any Act in force within the district requiring fireplaces and furnaces to consume their own smoke, at any time between the hours of nine in the forenoon and six in the afternoon; or in the case of a nuisance arising in respect of any business, then at any hour when such business is in progress or is usually carried on. In the case of tents, vans, sheds, and similar structures, entry can only be demanded between six o'clock in the morning and the succeeding nine o'clock in the evening.

Where under the Act a nuisance has been ascertained to exist, or an order of abatement or prohibition has been made, the local authority or any of their officers must be admitted from time to time into the premises between the hours aforesaid until the nuisance is abated, or the works ordered to be done are completed, as the case may be.

If admission to premises for any of these purposes is refused, any justice on complaint thereof on oath by any officer of the local authority may, by order under his hand, require the person having custody of the premises to admit the local authority, or their officer, into the premises during the hours aforesaid, and if no person having custody of the premises can be found, the justice shall, on oath made before him of that fact, by order under his hand, authorise the local authority, or any of their officers, to enter such premises during the hours aforesaid.

Any order made by a justice for admission of the local authority, or any of their officers, on premises will continue in force until the nuisance has been abated, or the work for which the entry was necessary has been done.

Where an order of abatement or prohibition has not been complied with, or has been infringed, the local authority, or any of their officers, are entitled to be admitted from time to time at all reasonable hours, or at all hours during which business is in progress or is usually carried on, into the premises where the nuisance exists, in order to abate the same.

It is the duty of every local authority to cause to be made from time to time an inspection of their district with a view to ascertain what nuisances exist calling for abatement under the powers of the Public Health Act, and to enforce the provisions of the Act in order to abate the same; also to enforce the provisions of any Act in force within their district requiring fireplaces and furnaces to consume their own smoke.

In addition to the above offences, which are described in the Public Health Act, 1875, as nuisances in every district, whether urban or rural, there is a section (s. 47) which is specially applicable to urban districts. It provides that every person who in an urban district (1) keeps any swine or pigsty in any dwelling-house, or so as to be a nuisance to any person; or (2) suffers any waste or stagnant water to remain in any cellar or place within any dwelling-house for twenty-four hours after written notice to him from the urban authority to remove the same; or (3) allows the contents of any water-closet, privy, or cesspool to overflow or soak therefrom, shall for every such offence be liable to a penalty; and the local authority must abate the nuisance in the manner indicated above.

Every urban authority has power to make by-laws for the prevention of nuisances arising from snow, filth, dust, ashes, and rubbish, and the prevention of the keeping of animals on any premises so as to be injurious to health. Under these powers the deposit and removal of accumulations of filth may be controlled, and the keeping of swine and other animals placed under restrictions. These powers are further extended where the Public Health Acts (Amendment) Act, 1890, is in force, for that enactment confers on local authorities power to make by-laws for prescribing the times for the removal or carriage through the streets of any fæcal or offensive or noxious matter or liquid, whether it is in course of removal, or carriage from within or without, or through the district; and requiring that the vessel, receptacle, cart, or carriage used for this purpose is properly constructed and covered so as to prevent the escape of any of the contents, and for compelling the cleansing of any place on which any such matter or liquid has been dropped or spilt in the removal or carriage.

Offensive Trades.—Offensive trades are at times a source of great nuisance, and this was recognised by the framers of the Public Health Act, 1848, the provisions of which Act have been substantially incorporated in the Act of 1875. It is there enacted that any person who establishes any of the offensive trades specified (which are the trades of blood-, bone-, soap-, and tripe-boiler, fellmonger, and tallow-melter), or 'any other noxious or offensive trade, business, or manufacture,' without the consent in writing of the urban authority, shall be liable to penalties. The defect of the earlier Act was that proceedings with respect to offensive trades could only be taken within the limits of a city, town, or populous district; and it was necessary to show that the person complained of was not using the best practicable means to abate the nuisance. Under the Act of 1875 the proceedings in question may be taken by the authority in any urban district, and the burden of proof that the best practicable means are used to abate the nuisance is thrown upon the defendant. Any urban authority may from time to time make by-laws with respect to any offensive trades established with their consent, in order to prevent or diminish the noxious or injurious effects thereof. It may be well to point out that any 'other' trade besides those specified in the Act to be within the powers of the Act must be *ejusdem generis.* Hence it has been held that brick-burning and the keeping of a fried-fish shop are not 'offensive trades,' but that the business of a rag-and-bone merchant is an offensive trade within the terms of the Act.

Slaughter-houses.—Closely allied to offensive trades are slaughter-houses, and as to these the powers of the Public Health Acts are very extensive. In the first place, every slaughter-house in existence before the Local Government Acts were in force in the place where it is situated has to be registered, and all new ones have to be licensed. Under the Public Health Acts (Amendment) Act, 1890, the license may be made an annual one. The local authority may make by-laws dealing amongst other things with the maintenance of the slaughter-houses in a cleanly and proper state, and requiring a sufficient supply of water to be provided.

Hospitals.—Of late years great progress has been made in dealing with infectious disease by the provision, under the powers of the Public Health Act, 1875, of hospitals to which patients can be removed. Any local authority may provide for the use of the inhabitants of their district hospitals or temporary places for the reception of the sick, and for that purpose may themselves build such hospitals or places of reception; or contract for the use of any such hospital or part of a hospital or place of reception; or enter into any agreement with any person having the management of any hospital, for the reception of the sick inhabitants of their district, on payment of such annual or other sum as may be agreed on; and two or more local authorities may combine in providing a common hospital.

Where any suitable hospital or place for the reception of the sick is provided within the district of a local authority, or within a convenient distance of such district, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, or is on board any ship or vessel, may, on a certificate signed by a legally qualified medical practitioner, and with the consent of the superintending body of such hospital or place, be removed, by order of any justice, to such hospital or place at the cost of the local authority; and any person so suffering, who is lodged in any common lodging-house, may, with the like consent and on a like certificate, be so removed by order of the local authority; and any person who wilfully disobeys or obstructs the execution of such order will be liable to a penalty not exceeding ten pounds. It is further provided by the Infectious Disease (Prevention) Act, 1890, that any justice of the peace, upon proper cause shown to him, may, where the Act (which is adoptive) is put in operation, make an order directing the detention in hospital, at the cost of the local authority, of any person suffering from an infectious disease, who is then in a hospital for infectious disease, and would not, on leaving the hospital, be provided with lodging or accommodation in which proper precautions could be taken to prevent his spreading the disorder. The order may be limited to some specific time, but any justice has power to enlarge the time as often as may appear to him to be necessary.

Notification of Infectious Disease.—The Infectious Disease (Notification) Act, 1889, and the Infectious Disease (Prevention) Act, 1890, both of which may be put in force in any district by being adopted in the prescribed manner, but are not in force otherwise, contain some very important provisions which it is proposed now to describe.

The Infectious Disease (Notification) Act, 1889, may be adopted by resolution passed at a meeting of the local authority, of which previous notice must be given to every member. When the Act has been duly adopted it is provided that where an inmate of any building used for human habitation is suffering from an infectious disease to which the Act applies, then, unless such building is a hospital in which persons suffering from an infectious disease are received,

(*a*) The *head of the family* to which such inmate (referred to as the patient) belongs, and in his default the nearest relatives of the patient present in the building or being in attendance on the patient, and in default of such relatives every person in charge of or in attendance on the patient, and in default of any such person the occupier of the building, shall, as soon as he becomes aware that the patient is suffering from an infectious disease to which the Act applies, send notice thereof to the medical officer of health of the district.

(*b*) Every *medical practitioner* attending on or called in to visit the patient shall forthwith, on becoming aware that the patient is suffering from an infectious disease to which the Act applies, send to the medical officer of health for the district a certificate stating the name of the patient, the situation of the building, and the infectious disease from which, in the opinion of such medical practitioner, the patient is suffering.

The certificate must be in the form prescribed by the Local Government Board, and must be given in respect of a case of infectious disease to which the Act applies occurring in any building, not belonging to Her Majesty, used for human habitation, unless such building is a hospital in which persons suffering from an infectious disease are received; and also in a case occurring in any ship, vessel, or boat not belonging to Her Majesty or to a foreign Government, or in any tent, van, shed, or similar structure used for human habitation and not belonging to Her Majesty, in like manner as nearly as may be as if it were a building. The penalty for default in sending the certificate is a fine not exceeding 40*s*. The forms of certificates are to be supplied gratuitously by the local authority, who will also pay for every certificate sent by a medical practitioner in accordance with the requirements of the Act a fee of 2*s*. 6*d*. if the case occurs in the course of his private practice, or a fee of 1*s*. if the certificate is given in respect of a case occurring in his practice as medical officer of any public body or institution. Where a medical practitioner attending on a patient is himself the medical officer of health of the district, he will be entitled to the fees to which he would be entitled if he were not such medical officer. It seems that if a medical practitioner in the proper exercise of his discretion certifies that a patient is suffering from any disease, his opinion cannot be subjected to review by the local authorities, and the fee to which he is entitled under the Act must be paid.

The infectious diseases to which the Act applies in all cases include the following: small-pox, cholera, diphtheria, membranous croup, erysipelas, the disease known as scarlatina or scarlet fever, and the fevers known by any of the following names: typhus, typhoid, enteric, relapsing, continued, or puerperal. If the authority of any district to which the Act extends desire that the Act shall in their district apply to any infectious disease other than the above, they may from time to time, by a resolution, order that the Act shall in their district apply to such disease.

It is of importance to note that the provisions of the Act apply to every ship, vessel, boat, tent, van, shed, or similar structure used for human habitation, in like manner as nearly as may be as if it were a building, and that a ship, vessel, or boat lying in any river, harbour, or other water not within the district of any local authority within the meaning of the Act, will be deemed for the purposes of the Act to be within the district of such local authority as may be fixed by the Local Government Board, and where no local authority has been fixed, then of the local authority of the district which nearest adjoins the place where such ship, vessel, or boat is lying.

Prevention of Infectious Disease.—The Infectious Disease (Prevention) Act, 1890, is also an adoptive Act, and is not in force until the prescribed forms for adopting it have been gone through; but it may be adopted in part only. The diseases to which it applies are the same as in the case of the Act of 1889, and the subjects to which it relates are—

(*a*) The inspection of dairies, and the prohibition of the supply of milk therefrom in cases where it appears that infectious disease is attributable to, or likely to be caused by, the consumption of milk so supplied;

(*b*) The cleansing and disinfection of premises, bedding, clothing, &c., for the purpose of preventing or checking infectious disease;

(*c*) The retention, removal, and burial of the bodies of persons who have died from infectious disease;

(*d*) The detention in hospital of persons suffering from infectious disease, who would, on leaving the hospital, be without proper lodging; and

(*e*) The provision of temporary shelter and attendance for members of families who have been compelled to leave their dwellings for the purpose of the dwellings being disinfected.

As during recent years attention has been very prominently directed to milk as a source of infection, it is not surprising to find that this Act confers powers which are considerably in advance of any which the Legislature has previously given to local authorities. On this subject the Act provides that in case the medical officer of health of any district in which the section is adopted is in possession of evidence that any person in the district is suffering from infectious disease attributable to milk supplied within the district from any dairy situate within or without the district, or that the consumption of milk from the dairy is likely to cause infectious disease to any person residing in the district, he shall, if authorised in that behalf by an order of a justice having jurisdiction in the place where the dairy is situate, have power to inspect such dairy, and, if accompanied by a veterinary inspector or some other properly qualified veterinary surgeon, to inspect the animals in the dairy. If, on such inspection, the medical officer of health is of opinion that infectious disease is caused from consumption of the milk supplied from the dairy, he is to make a report to the authority whose officer he is. This report must be accompanied by any report that may be furnished to him by the veterinary inspector or veterinary surgeon above mentioned. The authority may thereupon require the dairyman to appear before them to show cause why an order should not be made requiring him not to supply any milk from the dairy within the district, until the order has been withdrawn. If he fails to show such cause, they may make the order.

The Act also contains some important provisions in regard to the use of public conveyances for the conveyance of the bodies of persons dying of infectious disease, the disposal of infectious rubbish, and the cleansing and disinfection of houses and articles therein likely to retain infection. On the last subject the Act provides that where the medical officer of health of any local authority, or any other registered medical practitioner, certifies that the cleansing and disinfecting of any house, or part of it, and of any articles in it likely to retain infection, would tend to prevent or check infectious disease, the clerk to the authority is to give notice in writing to the owner or occupier that the house or part, and any articles in it likely to retain infection, will be cleansed and disinfected by the authority at the cost of the owner or occupier, unless he informs the authority, within twenty-four hours from the receipt of the notice, that he will do the cleansing and disinfection, to the satisfaction of the medical officer of health, within a time fixed in the notice. If, within twenty-four hours from the receipt of the notice, the person to whom it is given does not inform the authority that he will so do the cleansing and disinfection, or if, having so informed the authority, he fails to have the work done within the time fixed in the notice, the house or part of a house and articles are to be cleansed and disinfected by the officers of the authority under the superintendence of the medical officer of health, and the expenses incurred may be recovered from the owner or occupier in a summary manner. But where the owner or occupier of the house or part of a house is unable effectually to cleanse and disinfect it, and any article therein likely to retain infection, the officers of the authority, with the consent of the owner or occupier, may undertake the cleansing and disinfection at the cost of the authority.

No person may retain unburied, elsewhere than in a public mortuary, or in a room not used at the time as a dwelling-place, sleeping-place, or workroom, for more than forty-eight hours, the body of any person who has died of an infectious disease, unless he shall have obtained the sanction in writing of the medical officer of health, or of a registered medical practitioner.

In connexion with this Act it is of the greatest importance to bear in mind that it is an adoptive Act not only as a whole, but as to sections, so that before any particular enactment is acted on, steps should be taken to ascertain that it has been properly put in force in the particular district.

Dwellings of the Working Classes. Some very important alterations of the law were made by the Housing of the Working Classes Act, 1890, the principal of which related to (1) unhealthy areas, and (2) unhealthy dwellings.

As to unhealthy areas, it is provided that where an official representation is made to the local authority by the medical officer of health, that within a certain area in their district either (*a*) any houses, courts, or alleys are unfit for habitation; or (*b*) the narrowness, closeness, and bad arrangement or the bad condition of the streets and houses or groups of houses within such area, or the want of light, air, ventilation, or proper conveniences, or any other sanitary defects, or one or more of such causes, are dangerous or injurious to the health of the inhabitants either of the buildings in the said area or of the neighbouring buildings, and that the evils cannot be remedied otherwise than by an improvement scheme for the re-arrangement and reconstruction of the streets and houses within such area, the local authority, if satisfied of the truth of the representation, shall pass a resolution to the effect that such area is an unhealthy area, and proceed to make a scheme for the improvement of the area. Before the scheme can come into operation it has to be confirmed by provisional order, which requires the sanction of Parliament.

The law relating to the assessment of compensation payable under an improvement scheme in respect of any house or premises situate in an unhealthy area, provides that in such cases evidence shall be receivable by the arbitrator to prove—(1) That the rental of the house or premises was enhanced by reason of the same being used for illegal purposes, or being so overcrowded as to be dangerous or injurious to the health of the inmates; or (2) that they are in such a condition as to be a nuisance within the meaning of the Acts relating to nuisances (which are defined by section 2 as meaning as respects any urban sanitary district in England the Public Health Acts, and as including any local Act which contains any provisions with respect to nuisances), or are in a state of defective sanitation, or are not in reasonably good repair; or (3) that they are unfit, and not reasonably capable of being made fit, for human habitation; and that if the arbitrator is satisfied by such evidence, then the compensation—(*a*) shall in the first case, so far as it is based on rental, be based on the rental which would have been obtainable if the house or premises were occupied for legal purposes, and only by the number of persons whom they were under all the circumstances of the case fitted to accommodate without such overcrowding as is dangerous or injurious to the health of the inmates; and (*b*) shall in the second case be the amount estimated as the value of the house and premises if the nuisance had been abated, or if they had been put into a sanitary condition, or into reasonably good repair, after deducting the estimated expense of abating the nuisance or putting them into such condition or repair, as the case may be; and (*c*) shall in the third case be the value of the land, and of the materials of the buildings thereon.

As to unhealthy dwellings, the Act gives some powers that are far in advance of any previous law. It is declared to be the duty of every local authority to cause to be made from time to time inspection of their district with a view to ascertain whether any dwelling-house therein is in a state so dangerous or injurious to health as to be unfit for human habitation, and if, on the representation of their medical officer of health or any of their officers, or information given to them, it appears that any dwelling-house is in such state, to forthwith take the proceedings against the owner or occupier for closing it under the Public Health Act, 1875.

Under the Public Health Act it had hitherto been necessary that the proceedings should be taken with a view to the abatement of a nuisance, and that the works requisite to abate the nuisance complained of should be specified. This, however, is no longer the case, as summary proceedings may be taken for the express purpose of causing the dwelling-house to be closed, and appropriate forms are prescribed for this purpose.

The effect of the closing order will be to prohibit the using of the premises for the purpose of human habitation until, in the judgment of the court, they are rendered fit for that purpose. In making it the court may impose a penalty not exceeding 20*l*.

Where a closing order has been made in respect of any dwelling-house, and has not been determined by a subsequent order, the sanitary authority, if of opinion that the house has not been rendered fit for human habitation, and that the necessary steps are not being taken with all diligence to render it so fit, and that the continuance of any building being or being part of the dwelling-house is dangerous or injurious to the health of the public, or of the inhabitants of the neighbouring dwelling-houses, are required to pass a resolution that it is expedient to order the demolition of the building. Unless the building is promptly made fit for human habitation it must be demolished.

COUNTY OF LONDON.—It is necessary to explain that the law as set forth above relates to the whole of England and Wales, but does not apply to the county of London, for which there are several special Acts of Parliament. The Local Government Acts, 1888 and 1894, the Metropolis Local Management Acts, the Metropolitan Building Acts, the Public Health (London) Act, 1891, and some other Acts, prescribe the law relating to the constitution, powers, and duties of the London County Council and the Local Authorities in the Metropolis, and also the general provisions as to the laying out of streets, the construction of buildings, and the regulation of all matters of sanitation and public health. It would be impossible to go into these provisions here, but in many respects they are the same as those above described for the provinces.

W. A. CASSON.

SANITATION; SANITARY SCIENCE (*sanus*, sound).—Sanitary science treats of the principles on which health is maintained and disease prevented. The principal agencies which contribute to this result will be found treated of in this work under the following headings: BATHS; CONTAGION; DISINFECTION; EXERCISE; FOOD; HOSPITALS, Construction of; HYDROTHERAPEUTICS; IMMUNITY; PERSONAL HEALTH; PHYSICAL EDUCATION; POISONOUS FOOD; PUBLIC HEALTH; QUARANTINE; SANITARY LAW; SEA-AIR and SEA-BATHS; and VACCINATION.

SAN REMO, on the Riviera, Italy, near the French Frontier.—A well-sheltered, dry, mild, equable winter climate. Mean winter temperature, 54° F. Early vegetation. *See* CLIMATE, Treatment of Disease by.

SANTA AQUEDA, in Spain.—Cold sulphated and chalybeate waters. *See* MINERAL WATERS.

SANTA BARBARA, in Southern California.—A very mild, equable climate, on the Pacific coast. Temperature—mean annual, 61° F.; winter mean, 54°. Rainfall, 16 inches. Used for phthisis and other pulmonary affections. *See* CLIMATE, Treatment of Disease by.

SANTA FÈ. — The capital of New Mexico, at an altitude of 7,013 feet, in a dry and arid region. Lacks equability of temperature. Mean annual temperature 48° F.; relative humidity percentage, 45. More suitable for a winter than a summer residence for invalids. It is principally recommended as a winter residence for pulmonary affections on account of its combining a certain degree of warmth with altitude. *See* CLIMATE, Treatment of Disease by.

SARATOGA, in Saratoga County, New York, U.S.A.—Alkaline chalybeate and muriated alkaline waters, containing traces of iodine and bromine. The springs of Ballston, a few miles from Saratoga, are of a like character. *See* MINERAL WATERS.

SARCINA (*sarcina*, a pack or bundle).—This is a morphological term applied to various species of micro-organisms belonging to the group of Schizomycetes, which, developing by fission in three planes at right angles to one another, form more or less cubical aggregates of 4, 8, 16, 32, or 64 cocci, having the appearance of corded 'bales' or 'packets.' *See* MICRO-ORGANISMS.

So far as is known at present, these bodies are not pathogenic, but merely find a suitable habitat in the diseased conditions with which they are associated, but of which they are not the cause.

The most important species of sarcina in human pathology are the following:—

1. **Sarcina ventriculi.**—This species, first discovered by Goodsir in 1842, is of frequent occurrence in the stomach, and in the vomit of gastric dilatation from pyloric obstruction; in some cases of gastric ulcer and carcinoma without dilatation; and in rare cases of gastric catarrh. Sarcinæ are not sufficiently constant to be of much diagnostic value, and are certainly not pathognomonic of a dilated stomach, as has been supposed. Their appearance is usually associated with a state of fermentation of the gastric contents, which appear like yeast, and are of an acid reaction and smell; but it would seem that the organism is developed in the progress of the fermentation, and is not the actual cause of the condition, for, when placed in suitable surroundings, living sarcinæ have not been observed to set up fermentative changes, and cases are recorded of their occurrence in vomit that showed no signs of fermentation.

Sarcinæ are easily detected under the microscope. A drop of liquor potassæ added to a fragment of vomit on the glass slide, and covered with thin glass, is sufficient to display their characteristic appearances. The constituent cells are of a diameter of about $\frac{1}{12000}$ of an inch (*see* fig. 137).

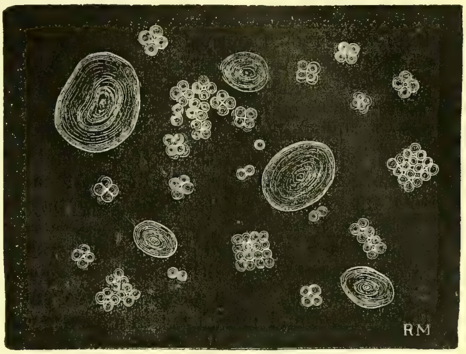

FIG. 137.—Sarcina ventriculi. Showing sarcinæ and starch-granules in vomited matter. × 400 diam.

2. **Sarcina pulmonum.**—This species has been described as occurring in certain lung-states associated with suppuration. It is said to readily induce ammoniacal decomposition of the urine when introduced into this fluid; and in one case appeared to contain starch or cellulose in its composition.

3. **Sarcina urinæ.**—This species of sarcina is of much rarer occurrence, and has been occasionally found in the bladder. It is much smaller than the gastric species, and the 'bales' usually consist of a greater number of cocci.

Sarcinæ are also stated to have been found in the fæces, in the ventricles of the brain, in hydrocele fluid, in gangrenous intestines, in cholera stools, and even in the blood.

W. H. ALLCHIN.

SARCOCELE (σάρξ, flesh; and κήλη, a tumour).—A name for any solid enlargement of the testes. *See* TESTES, Diseases of.

SARCOMA (σάρξ, flesh).—A tumour composed of some modification of embryonic connective tissue. *See* TUMOURS.

SARCOPTES SCABIEI. — A synonym for acarus scabiei. *See* ACARUS.

SATURNISM (*saturnus*, lead). — A synonym for lead-poisoning. *See* LEAD, Poisoning by.

SCABIES (*scabies*, scab, mange). — SYNON.: Itch; Fr. *Gale*; Ger. *Krätze.*

DEFINITION.—A simple inflammation of the skin, produced by the irritation of the *acarus scabiei* and the scratching of the sufferer. The disease is contagious, as the parasite is easily transferred from one person to another.

Description.—The parts of the body most likely to be attacked are the soft skin between the fingers, and on the flexor side of the wrists and elbows; the lower part of the abdomen, buttocks, and penis; and in women the mammæ; in children the feet and legs, in addition to the other parts of the body already mentioned, are very liable to be attacked. The acarus generally attacks both sides of the body symmetrically, and in adults is never met with in the skin of the face or scalp; but any other part of the body may be affected.

The eruption produced by the acari and by scratching is attended with itching, especially at night, and resembles a scattered eczema; and the extent and severity of the disease will depend chiefly on its duration. The most characteristic feature for the purposes of diagnosis is the scabies burrow, which resembles roughly an old pin-scratch. Examined closely, it has a dotted and beaded appearance with ragged dirty edges at its entrance, where the roof of the cuniculus has been worn away by rubbing. At the distant end of the burrow may be sometimes seen the parent acarus, which is easily extracted by inserting the point of a pin along the burrow and touching the acarus, which immediately adheres to the pin, and may thus be removed for the purpose of examination.

Diagnosis.—The following points serve to distinguish scabies: (1) the particular parts attacked above indicated; (2) the eruption, which consists of scattered and isolated papules and vesicles, and more rarely pustules, with their tops more or less torn by scratching; (3) the history of the case, and especially of contagion; (4) the presence of the scabies burrow; and (5) the demonstration of the acarus by means of the microscope.

Treatment.—The usual plan of treating scabies is by the use of either (1) sulphur ointment; or (2) sulphur baths or lotions. The former is the more effectual method, although the latter may be occasionally preferred. In order to cure an ordinary case of scabies, it is simply necessary that the patient, before going to bed, should thoroughly apply and gently rub in the sulphur ointment to every part of the body, excepting the skin of the face and scalp; and in order to keep the ointment in contact with the skin, he should sleep in his under-clothes, such as drawers, jersey, socks, and gloves, and in the morning take a warm bath and put on clean clothes. This process should be repeated for three or four nights, after which the ointment should be used every night for a week or ten days to those parts of the body only which are especially attacked by the disease.

The ointment should contain a drachm of sulphur to an ounce of benzoated lard, but for young children an ointment of about half this strength is most suitable. A common mistake is to continue the use of the strong sulphur ointment of the Pharmacopœia for several weeks, thus producing an irritable state of skin, which is mistaken for a continuation of the scabies.

If a sulphur bath be preferred, it may be made by dissolving half a pound of sulphurated potash in thirty gallons of water. It is necessary to repeat the bath several times at intervals of a few days.

If it be desired to treat scabies by a lotion, Vlemingkx's solution may be used. It is made by boiling five gallons of water with a quarter of a pound of quicklime and half a pound of sulphur until three gallons are left. This lotion is effective, but it is apt to irritate the skin, and is not so generally useful as the sulphur ointment. *See* Acarus.

R. Liveing.

SCALD.—An injury to any part of the body caused by the action of moist heat, either in the form of steam or of a hot fluid. *See* Heat, Effects of Severe or Extreme.

SCALD-HEAD (*scall*, scurf; scabbiness). A popular term, commonly used as the negation of ringworm; all diseases of the scalp, in the belief of the people, being either ringworm or scald-head. The term finds a more suitable application to that form of folliculitis of the scalp which is denominated *kerion.* Kerion begins with circumscribed tumefaction of the scalp and profuse exudation from the hair-follicles, and terminates by elimination of the hair and baldness; the latter being generally temporary, but sometimes permanent.

Erasmus Wilson.

SCARIFICATION (*scarifico,* I make an incision).—This is an operation in which small superficial incisions are made, through either the skin or mucous membrane, to allow the escape of blood, as in wet-cupping, or of serous fluid, in relieving dropsical effusions; or to liberate the teeth, as in difficult dentition.

SCARLATINA.—A synonym for scarlet fever. *See* Scarlet Fever.

SCARLET FEVER.—Synon.: Scarlatina; *Febris Scarlatina*; Fr. *Scarlatine*; Ger. *Scharlach.*

Definition.—An infectious specific fever; with sudden ingress, soreness and redness of the throat, and a finely diffused scarlet rash on the second day, most intense on the third day, beginning to fade on the fifth or sixth with some subsidence of fever, and followed by desquamation of the cuticle, in both small and large flakes; and inducing a liability to rheumatic and renal symptoms and a tendency to serous effusions.

Ætiology.—Some product of the sick, however conveyed to those hitherto unaffected and susceptible, always reproduces this disease, which again gives off infecting material with identical properties. No other origin for scarlet fever can now be admitted; its extension to any new locality is traceable to an imported infection. The periodical recurrence of epidemics in large communities is mainly attributable to an increase in the number of the susceptible. Wherever scarlatina spreads, children are the chief victims. Even among people not protected by a previous attack, a less liability is noticed with advancing years.

In adults, unless specially predisposed, the attack is less severe than during adolescence and childhood. The disease is most frequent from the second to the sixth year, and most fatal to children of two and three years old, when the mortality is 20 per cent.; this seldom exceeds 5 per cent. after the age of five years. In England, where scarlet fever prevails more than in any other country except, perhaps, the United States, and causes the highest mortality of any epidemic disease, two-thirds of all the deaths from it occur in the first five years of childhood. Five per cent. of the whole mortality falls in the first year, 15 per cent. in the second, 20 per cent. in each of the next two years, thence progressively decreasing—that for all ages over fifteen being less than 5 per cent., and more than half of these deaths being in the next decade. The following decade shows a slightly increased incidence on women, partly because they are more with the sick, and partly from a greater susceptibility after childbirth. Sex has no directly predisposing influence. The proportional mortality from scarlet fever is about 8 to 10,000 of population in England and Wales, the range being from 0·5 to 1·5 per 1,000; in Liverpool this has reached to 3·7, and in London to 2 per 1,000. From 2 to 5 per cent. of all the yearly deaths are from this disease; in London this proportion varied from 8 per cent. in 1870, to 1 per cent. two years afterwards. Epidemics of scarlet fever are not evenly distributed—they subside in one place while they extend in another; in epidemic years (as 1863, 1870, 1887, and 1892) the increase becomes very general. From our large towns scarlet fever is seldom or never absent; among sparse populations the disease may not reappear for years.

The influence of season on scarlet fever is marked with us by an autumnal increase of the disease: the number of deaths from it in London is always at its highest at the end of October. Cold has very little effect on the intensity of the disease; but indirectly may check its spread. Heat favours its diffusion, but lessens the severity of the attack and of its after-consequences. Epidemics tend to recur every five or six years, as a fresh series of the susceptible arises. They often extend with us in dry seasons, and subside after wet ones. Whatever the relation of moist air and subsoil water to other infections, in this one rain may free the air of floating particles, and carry them off by the sewers.

A defective hygiene from imperfectly drained dwellings greatly increases the dangers of this disease. Defective ventilation will aggravate the type, or intensify the infection which a free ventilation would dissipate. The best conditions of personal hygiene are often powerless in modifying the dangers of individual liability. The healthy and well-to-do enjoy no exemption. No mildness of type in the infecting source is any safeguard against the dangers to follow, even to members of the same family. Individual susceptibility is most variable: sometimes persons in not very good health escape while with the sick, but on returning in improved health to them as convalescents, or to the house they have left, are at once seized. After surgical operations the predisposition to receive infection is increased; any shock or injury may determine a seizure after an exposure otherwise harmless. How long after quitting an infected place such injury may excite disease is uncertain. An idiosyncrasy to suffer seriously from this kind of disease marks even the robust in certain families; in others there is a liability to more than one attack. The rule against a recurrence prevails so largely as to be the great element of personal safety to anyone again exposed to infection. Any person, however safe, may be the carrier of infection; not only the hands that have touched the sick and things in actual contact with them, but clothes or even papers that have been in the sick-room, may convey it.

Infection attaches to the whole period of illness. Greatest at the height of the disease, it is given off for six weeks—it may be for nine and ten weeks, after. Second attacks have occurred six or eight weeks from the first seizure; in some of these cases recrudescence of an originally mild attack seems likely, with further sore-throat and followed by freer desquamation. A relapse is possible as late as the fourth week; this, if not a re-infection, prolongs the duration of the infectious period; so also may any serious complication delaying convalescence. During all this time infection may be received by clothes or near surfaces, and retained by them for months, unless driven off by cleansing and disinfectants. A dry heat of 220° will disinfect woollen clothing; a curtain from the bed of a child only sickening for scarlet fever, folded and put away without such care, has set up the disease after a long interval. Clothes removed to a distance and unpacked months afterwards will give off infection. Persons protected by a previous attack from again undergoing scarlet fever, may, when much exposed to it, have sore-throat or other signs of partial sickening, sufficient to carry the disease elsewhere. Every case of sore-throat occurring in an infected house is capable of conveying scarlet fever, whether the subject of it be protected or not. Sore-throat in children is always a sufficient reason for keeping them at home. It is the slight cases of infectious sore-throat, not bad enough to prevent children from going out of doors or being sent to schools and parties, that elude our efforts to arrest epidemics of this kind in their usual course. Infection begins at the very commencement of sickening, but at that time is more readily controlled. Scarlet fever having gained entrance into a healthy house need not spread; timely isolation of the first case, or separation of the susceptible, is mostly successful, for the rash is an early symptom at once attracting attention. If others have received infection the sickness will appear in less than a week, when a second separation is sure to be effective. Till the week is over, those who may have escaped are not to be sent among other families.

The period of incubation is a short one. Not more than from three to five days, it is said to be as short as three hours; it may possibly extend to seven or ten days. The longest interval known to the writer from a single definite exposure to sickening has been four and a-half days. In most of the instances where four to five days have intervened, one or two of these days have not been without sore-throat or other signs of invasion. Such cases are infectious before the seizure is definite. In separating children from an infected house, anyone who has received infection is sure to show evidence of it before the week end. The only exceptions to this rule are, where some communication has been kept up with the infected house, where clothes have retained infection, or some source of it has existed in the second house. All accurate investigation of the cause of infection in scarlet fever tends to reduce the estimate of the average incubation-period to less than three days. In the longer periods adduced it is probable that infection attaches to something without, instead of immediately acting on or within, the sufferer. A week or more may intervene between successive cases in any family, when precautions sufficient only to delay the spread of infection have been maintained.

Inoculation will reproduce scarlatina, all the symptoms appearing with the usual rapidity and not less than the usual severity. Some modification has resulted from inoculating a serous exudation from the skin during eruption: redness began at the point of insertion in thirty hours; this extended during three days, faded after five days, and proved protective. Attempts at implanting the disease by desquamated epidermic scales have mostly failed; as with diphtheritic exfoliations, the active contagion is not long or intimately associated with dead material. The particulate contagion, carried in the blood, can permeate everywhere, for mothers ill from scarlet fever have given birth to infants affected with sore-throat; yet the mother may suffer, and the child escape. Animals are inoculable with the blood of persons with scarlet fever. A dog has contracted fever and bad throat from being in bed with a scarlet-fever patient; such illness is not necessarily identical with that originating it, nor need it be directly transmissible as a specific disease either to dogs or men, but we see how pet animals may carry infection from one person to another.

Infection has many times been traced to milk. The facility with which this fluid will absorb and convey infection is very remarkable: for it to stand in the room with sick people is enough to cause it to be tainted; the cream is specially prone to impregnation. In some cases convalescents from scarlet fever, in others healthy persons coming from an infected house, have milked the cows, and handled or distributed the milk. In this way sore teats in the cow may convey infection.

PATHOLOGY AND ANATOMICAL CHARACTERS. Scarlet fever results from the entrance of an infecting particle into the blood; but how minute or of what nature is uncertain. Micrococci are found in the blood during this fever, even within the corpuscles; and in the serum rapidly oscillating bodies appear as dark specks among the globules; also small rod-like bodies, single or joined, have been described. Such serum injected under the skin caused sudden fever in the rabbit, with similar bodies in the blood, again inoculable. Not only the blood and serum of the subject of scarlet fever, but most secretions of the body, carry infection. Minute spores, similar to those in the blood, traverse membranous septa, and have been found in the renal epithelium. Most abundant in the breath, infection attaches also to the nasal or pharyngeal secretion. The first serous exudation from the skin has been used for inoculation; desquamated cuticle is less effective. Infection is generally received by the throat and lungs, seldom by a wound or abrasion of the skin, and never by the unabraded skin. At first it multiplies at the point of reception, hence probably the day or two of sore-throat; it is delayed but little in the lymphatics before entering the blood. Infection is most rapid when carried direct to the lungs, as when inhaled through a tracheotomy tube, no particles being detained on the pharynx. Many of the first effects of the disease, such as the quick pulse and nerve-disturbance, are directly attributable to the raised body-heat. The state of the skin adds to the fever, secretion is checked, there is a general hyperæmia (not specially of the papillæ as in measles), with serous exudation in its upper layers. A bad throat gives rise to irritating and injurious secretions, keeps up the fever, and interferes with the supply of necessary diluents. The products of increased tissue-change are imperfectly eliminated by the kidneys. Further stress on the kidneys is caused, partly by the high fever, and partly by a special irritant in the blood acting upon its vascular and secreting structures. This renders the renal tissues prone to suffer, and to continue irritable. Any febrile albuminuria mostly passes off in the first week. The specific scarlatinal nephritis occurs from the end of the second to the third or fourth week of illness; but the vascular changes begin early, chiefly in the cortical part of the kidney; the glomeruli are obstructed by a proliferation of epithelial nuclei, distending them to twice their size, and so compressing the vascular tuft; there is hyaline degeneration of their capillaries, and in the elastic intima of the afferent vessels, which has been found after two days' illness (Klein); also thickening of the small arteries in other parts, with germinating nuclei in the muscular coat. The brunt of the disease falls first on the glomeruli; thence arise stasis and hyperæmia of intertubular capillaries; then signs of parenchymatous nephritis, with cloudy swelling of epithelium-cells, increase of their nuclei, and granular change in some of the convoluted tubes, may be found. Sometimes there is granular matter or blood in them, and in the cavity of Bowman's capsule. Hyaline spherules from these appear in the urine; and epithelium in some cases begins to be detached from the larger ducts of the pyramids. After the first week changes due to interstitial as well as to parenchymatous nephritis commence. The connective tissue round the larger vessels is infiltrated with lymphoid cells, thence spreading to the base of the pyramids and to the cortex, some parts of which become pale and firm, and the tubules obliterated. After this process has reached a certain degree, the evidence of parenchymatous change increases—crowding of the urinary tubes with lymphoid cells, granular and fatty degeneration of epithelium, with casts or cylinders of various kinds in the tubes, and abundant products of inflammation. These changes may commence round an artery plugged with fibrin; they lead to enlargement of the kidney, with obliteration of tubules and Malpighian corpuscles, the latter undergoing fibrous degeneration. Klein also describes early interstitial hepatitis. He found the same hyaline degeneration and thickening of arteries in the spleen and intestines as in enteric fever, but most marked in the spleen, with degeneration of surrounding adenoid tissue. Veins obstructed with fibrin were found in the cervical glands, with degenerative changes; in the centre of the lymphatic follicles here, and in the pharynx and tonsils, the lymph-cells were replaced by large granular cells.

Thickening of the walls of the smaller arteries, and some change in the capillaries of the pia mater, have been noticed in this as in other acute fevers, otherwise the early cerebral symptoms are not marked by anatomical change. In uræmia leucocytes are found in the perivascular spaces of the brain and cord. Later cerebral mischief, except from caries of the temporal bone, is more rare than after measles; but disseminated sclerosis may result. Hemiplegia from embolism has occurred in the second week of scarlet fever. Besides the results of endo- and peri-carditis, blood-clots and fibrinous coagula are found in the heart. Cardiac dilatation, or pneumonia, may follow upon uræmia. The blood in scarlet fever has been said to be deficient in fibrin; fibrin is less readily formed in this, as in other specific fevers, until some secondary inflammation arises; in the after-dyscrasia it more readily separates. Tubercular peritonitis has followed.

Ulcerative endocarditis, or suppurative synovitis, almost as certainly fatal, may occur. After death septicæmic micrococci are found in obstructed capillaries; but septicæmia itself has a rash like that of scarlet fever. The streptococci of secondary suppuration may be associated with scarlatinal infection. Among the secondary lesions of scarlet fever are the ulceration and suppuration of inflamed glands, with sloughing of the cellular tissue around them or in other parts. Fatal hæmorrhage from the throat has resulted from an injured artery. Good recovery has been made after sloughing in the neck had extended to the sheath of the carotid, exposing all the deep muscles, and leaving the salivary glands bare.

SYMPTOMS.—The invasion of scarlet fever is abrupt. The ingress of fever is seldom marked by rigors, not always by chilliness. Slight pallor, languor, vertigo, drowsiness by day, restlessness, starting, or delirium at night, aching of the limbs and forehead, sore-throat, and vomiting, are common. In children convulsions or coma may occur. Sudden illness comes on within an hour of apparent health, or after a day or two's warning sensations in the throat. The temperature begins to rise at once, the pulse becomes very rapid—and this is sometimes more marked than the rise in temperature; but soon suffusion of the eyes, flushing of the face, and great heat succeed, with thirst and pain in deglutition, or stiffness of neck. The deep lymphatic glands at the angles of the jaw can be felt enlarged and tender; already the arch of the palate and both tonsils are red; the redness extends a little on to the palate; the tongue is furred; its fungiform papillæ prominent, bright red, and bare; its edges and tip red. Coma, convulsions, or vomiting may persist, with considerable depression, and yet the temperature be near 105°; it may even reach 106° F. at this early stage. More frequently the greatest disturbance of pulse and temperature is from the third to the fifth day of the fever. Very often a fine flush of redness suffuses the neck and chest soon after the sore-throat is complained of, perhaps within a few hours of the first suspicion of illness.

The *eruption* may thus be among the earliest obvious signs of the disease. It generally appears by the second day, and is well established on the third; but it may be delayed, or suppressed, or recede, and then the severity of the prodromata serve as a guide.

The rash begins in fine red points, with diffused redness around, so as to leave no clear skin between; or red patches are formed in some places, as in the flexures of the joints. The finger-nail drawn firmly across this redness on the abdomen or thigh leaves a white streak where the vessels contract for a time; after steady pressure the skin is of a yellowish tint; or petechiæ may be seen. The sides of the neck, the face, and the chest first show the rash, which soon spreads to the trunk and limbs; or it may come out on them at once. The skin is exceedingly hot, not always dry, sometimes with free perspiration. Miliaria often appear where the rash is most intense; these minute exudations are not the result of perspiration, though sudamina may occur. The eruption reaches its fullest extension and intensity by the fourth day, fading on the fifth and sixth. The heat and swelling then subside, and the skin feels dry and inelastic, or a partial subcutaneous œdema of the eyelids, feet, or hands is noticeable; in other parts the cuticle is easily thrown into fine wrinkles, and is ready to desquamate. Desquamation begins from the sixth to the ninth day, when the specific morbid process is subsiding.

Sore-throat is always present; some traces of this are observable the day before the seizure, or from the time of receiving the infection, often with diarrhœa. During the attack the redness spreads from the tonsils to the palate, uvula, pharynx, and epiglottis; it becomes more intense, and there is swelling with some œdema. The mucous membrane is either dry and shining, or coated with thick mucus clogging the fauces. The tonsils project and are smeared with sticky secretion, while sometimes there is abrasion of their surface or ulceration, rarely abscess. These conditions and the symptoms they produce are worst during the first three days of the illness, and subside as the rash is thrown out. After the first week, in severe cases, ulceration, not confined to the tonsils, may occur. The connective tissue around the lymphatic glands in the neck becomes brawny and may slough, that under the lower eyelid may suppurate. Persistent coryza stuffs the nostrils with acrid discharge, or, extending along the Eustachian tube, fills the middle ear with pus, bursting the tympanum, deafness not being the only or worst result. Otorrhœa from the meatus is less serious; this is not at first purulent. The tongue is red and bare after the eruption, with a 'strawberry' appearance as the fur clears away. The mucous surfaces are left tender, and care as to ingesta is required. There may be also much and serious trouble with deglutition. Vomiting, the most constant of the ingressional nervous signs, rarely persists as a gastric symptom. The tendency to diarrhœa may continue, but constipation is rare, except as an after-consequence.

The *pyrexia* of scarlet fever is characteristic. High at the first, it keeps high, or rises higher for three or four days; there is then a marked, though incomplete, subsidence after the rash is thrown out, mostly on the fifth or sixth days, sometimes earlier; but the temperature rarely becomes normal till the second week, some fever lingering after the eruption is over. When the greatest tension of skin is passed, the surface temperature has been found on the fifth and sixth days at 97°, with 101° *in axillâ* and 105° *in recto*; the latter keeping at 103° for two or three days longer. A crisis is to be looked for on the fourth or fifth day; defervescence not till the eighth or ninth; and this is often further delayed by complications or relapse. There are no other constant remissions during the febrile period, but some nocturnal exacerbations occur during the first part of it, often associated with harmless delirium. The persistence of more serious delirium then and later in persons of all ages points to meningeal irritation. Coma in children may depend not only on the high temperature, but on the state of the arachnoid cavities; even hemiplegic signs have occurred independently of the embolism so often consequent on endocarditis. Uræmic coma is rare. Intracranial inflammation and abscess not infrequently result from caries of the temporal bone after otitis.

The chief *respiratory disturbances* are, at first, irritative cough, and symptoms resulting from œdema of the glottis; the breathing is always quickened when the pulse is rapid and the fever high. Pleurisy with effusion has occurred at all periods of scarlatina, more frequently in the later stages, with a limited pneumonia, pulmonary congestion, or broncho-pneumonia.

On the side of the *circulation*, besides the quick pulse, often slow or irregular about the third week, there is the liability to endocarditis during the eruptive period or later, and to pericarditis; these complications often prolong the duration of the fever, seriously affect the nutrition of the heart, and give rise to dilatation with special symptoms and dangers. Vascular tension is not much raised in scarlatinal albuminuria.

The *urine* is altered as in other fevers; the increase of nitrogenous waste, in proportion to the degree of fever, is eliminated most largely at the crisis. At first the quantity of urine is less; the chlorides, much diminished, reappear as the fever declines; the urea, relatively increased, is less absolutely so than it is afterwards with a freer excretion; urate of sodium is deposited; uric acid, diminished on the second and third days, increases at the febrile crisis, often appearing in abundance on the fifth and sixth days, then again normal, but increasing after rheumatism or other febrile disturbance; phosphoric acid, normal during the first four days, is much diminished on the fifth, then remains below the standard till the eighth or ninth day, when there is often a deposit of earthy phosphates, with a pale, barely acid urine. Oxaluria may follow.

The kidneys, almost as constantly as the throat and skin, are the seat of important changes, to which the state of the urine is a trustworthy guide; this consequently must be the subject of repeated examination. At first there may be partial suppression of urine for a day or more; this yielding, tube-casts, blood, and albumin are found, clearing off as the secretion becomes freer. Such transient albuminuria may occur in other fevers, but here the first congestion of the glomeruli increases—it may be while the skin-affection is at its height, more frequently in its decline—and a distinctive form of nephritis is set up, generally about the ninth and tenth day, when the skin is desquamating. This has a marked febrile disturbance of its own, often leads to chronic kidney-disease, and is attended throughout with albuminuria. Dr. Ashby says about 6 per cent. of the Manchester hospital cases suffer from post-scarlatinal nephritis; he notes a greater fatality in such cases following upon severe throat-lesion without any apyretic interval. Later in the disease albuminuria and hæmaturia set in without rise of temperature. Both these conditions are often followed by dropsy. Albuminuria commonly begins during the desquamation-period in the second week; possibly as early as the fourth day; rarely as late as the thirty-first day. Three stages of this condition are noticed. The quantity of urine in the first stage is much diminished, the urea even more in proportion than the water; the specific gravity is increased; the turbidity from deposited urates is cleared by heat or the addition of hot water, showing no smoky tint from blood. If this stage be prolonged, albumin is found, with finely granular or clear casts; seldom with blood-discs or renal epithelium; but they, together with epithelial tube-casts, are freely washed out as this stage is passing away. The second stage is marked by diuresis; the pale urine of low specific gravity acquires a smoky tint from blood-discoloration; this may deepen to brown or give a brighter red deposit. Albumin to a large amount may pass, with pale urine, when there is but little blood; the whole quantity of albumin may be greater, though proportionally less than in the earlier stage; it diminishes towards the close of this period, as the urine gradually clears. Some blood-corpuscles, renal epithelium, and tube-casts are found in the deposit. Clear urine still in excess and slightly flocculent marks the third stage, in which the albumin gradually, but not always entirely, disappears.

The urine may not be much lessened at first, in mild cases, and yet afterwards become albuminous; or a well-marked first stage in a severe case is not always followed by albuminuria. This is often a specific effect of the disease and independent of chill. Anuria, here as in measles, has been met with on the decline of the rash. There may be hæmoglobinuria in the later stages, with deep bloody colour, and no great increase of albumin.

Hæmaturia, if partly dependent on a blood-state, is one of the more obvious indications of kidney-mischief. Another is afforded by the occurrence of scarlatinal *dropsy*. Allowing for an error from mere surface-œdema being mistaken for it in the first week, and later for the effects of anæmia, anasarca is fairly indicative of albuminuria past or present.

Albuminuria may be absent, or only have existed for a day or two before the anasarca or ascites began. Anæmia is a very marked late feature of the disease, so that pallor and chronic dropsical cachexia often go together. Apart from renal dropsy, there is a form of scarlatinal dropsy which occurs suddenly in the second or third week, as the result of a special inflammation of serous membranes, often associated with rheumatism, or with some degree of albuminuria. *Serous effusions* into the pericardium or pleuræ, indicated by dyspnœa, are ascertained by their distinctive physical signs. They are part of a general tendency to inflammation of the serous membranes. Pleurisy is more commonly associated with albuminuria; it may tend either to hydrothorax or to empyema. Pericarditis is more commonly associated with rheumatism.

Rheumatism is frequently induced by scarlet fever; before the end of the first week, just after the rash is fullest, pains begin in several joints—wrists, ankles, or knees; the fever, instead of subsiding, rises; and the pulse again becomes quick, full, and hard. At this time pericardial friction is to be looked for, or an endocardial murmur may be heard either at base or apex; an apex murmur is sometimes heard when there is neither rheumatism nor albuminuria, and may not necessarily mean endocarditis. Pains in the limbs, or arthritic symptoms, may come on as late as the third week, with renewed fever of the rheumatic type, sometimes with profuse perspirations. The articular swellings mostly subside, but there is also, unlike what is seen in rheumatism, the possibility of suppuration.

Sloughing of the cellular tissue around inflamed glands, or of the skin over them, is a more frequent and less fatal evidence of the same tendency. Sometimes diphtheritic necrosis of mucous membrane, or of blistered and ulcerated surfaces, after scarlet fever, evinces a specific dyscrasia.

Desquamation begins earliest where the rash has been most intense. It may be seen as early as the fourth day, more frequently on the sixth and seventh; rarely it is delayed beyond the tenth day, it may be to three weeks; and it is seldom completely over in less than six weeks. The desquamation period, really the whole time of cure, is also spoken of as occupying the second week, and as marked by a subsidence of fever even to below the normal. There is generally a remission of fever at this time, but without any great depression of temperature; the pulse also is weak, and may be irregular; considerable depression and a sense of debility about the tenth day are frequently to be noticed. All this, if coincident, can hardly be consequent upon desquamation. As soon as the vessels of the skin are less tense, the wrinkled epidermis becomes scurfy and separates. This is first seen on the chin and sides of the neck, the less delicate cuticle being raised and removed on small patches, which increase as the edges are detached, leaving a large new surface of skin; the thick epidermis of fingers and feet peels off in larger flakes, or in casts. A shreddy look of hands or toes may betray a mild attack of scarlet fever, overlooked, from three to six or eight weeks before. After well-marked scarlet fever the desquamation may be slight.

New cuticle is rapidly formed during convalescence, and is more than once cast off and renewed. Sometimes there is a pause in this process, and desquamation is thought to be over, when, with change of air or improved nutrition, a further peeling of what seems healthy cuticle occurs, not without risk of a further dissemination of infection, up to the ninth week of convalescence. Any form of desquamation beginning later than this can seldom or never be the bearer of infecting particles; even the flakes of a second desquamation carry infection so loosely as to be readily deprived of it by the ordinary means of washing and exposure. In fact, desquamation, though a very good sign that infection still attaches to its subject, because recovery is barely complete, is not the only, nor even the chief, means of its diffusion. The first fine desquamation is more infective than the later shreds.

But infection is given off before this is formed, as well as after it is all over. The secondary lesions of the throat, nose, and lips are infectious; abscesses, formed more than three weeks after the disease began, yield an infecting pus contaminating specifically the lancet used for their evacuation; nor can any definite time less than six weeks be fixed when the specific morbid process may be supposed to have ceased. A kind of recrudescence, but without the reappearance of the rash, would seem possible up to the eighth week; and the casting off in the tenth week of *débris* of tissue formed perhaps a fortnight before, as in menstruation, may not be without the elements of infection. Children are very liable to weak throat or a return of coryza for some months after convalescence from scarlet fever.

Varieties.—1. *Scarlatina mitior*, called also *scarlatina simplex* or *benigna*. The rash appears only on parts of the skin, and soon fades; the throat, hardly sore, is of a pinky red, with tonsils just rounded, the back of the pharynx, perhaps, streaked with mucus from the small glands; the fever is so slight that it is said to be absent; the early fine desquamation escapes notice; and it may be three, four, or five weeks before peeling on the hands and feet proves the true nature of the illness. Some mild cases begin with well-marked rash, and rapid pulse, but no high fever; the temperature, rising to about 100°, falls on the third or fourth day. These cases are not over in the third week; but there is no great illness; the rash is forgotten, and precautions are relaxed till some anasarca is noticed, or other subjects are ill with more marked symptoms. Desquamation is not later after a mild attack, nor more prolonged than after a severe one, but it may be the only distinctive sign left of a marked impairment of health and of its cause.

2. *Scarlatina gravior*.—This includes all the more serious cases, some called *scarlatina anginosa*, when endangered by the severity of the throat-symptoms; others *scarlatina maligna*, when marked from the first by high fever or its consequences. This latter form is known also as the *adynamic*, when exhaustion or collapse rapidly ensues, in some cases even before the rash has had time to appear. If cardiac failure be less sudden, such cases are shown by septic pneumonia after a sloughing throat, or pyæmia with multiple abscesses and small hæmorrhages in the kidneys or elsewhere. There are all grades of severity between these and the slighter forms of the disease. We sometimes see the mildest kind of attack in

one child set up the worst form in another; or the disease may begin moderately, and bad symptoms appear on the third or fifth day, such as restlessness, depression, weak and rapid pulse, dusky rash, lividity or pallor, dysphagia, sore mouth, dry tongue, tympanites, and cold perspirations. Again, these signs of exhaustion may follow upon some complication in the second week, while the temperature is still high; or appear as late as the fourth or fifth, after great emaciation, when the fever is over. Diphtheria, either of mucous surfaces or of the skin, appears in some of these cases, not as a new infection, but as one result of the disease. So among several children with scarlet fever, one may have only a faint rash, slow to appear, soon fading, or perhaps again returning, called *scarlatina anginosa maligna*; but the appearances in the throat and other signs are those of diphtheria; or one child with such a throat and no noticeable rash has started scarlatina among others. Some malignant cases, mostly fatal, show extreme prostration from the first, with rapid pulse and grave nervous disturbance; the temperature is always high—105° or more, even when the skin feels cool. Several of these fatal cases follow one another in a household, either from a developed intensity in the infection, from a family predisposition to suffer from it, or from some such tendency to excessive temperature-disturbance.

The infection of scarlet fever is readily received, by those who have not previously suffered from it, in the course of most diseases; and in many of them it proves a serious complication. *Surgical scarlet fever* differs in no respect from ordinary scarlet fever; it will spread to the susceptible who have no wound or open sore, not to those who are protected by a previous attack, though in the same ward and recently operated on. One attack of scarlet fever is so generally protective against a recurrence that the not infrequent instances of exceptions to this rule in no way invalidate the more important practical deductions from it; those who have already had it may attend on the sick or mix with convalescents. Some persons have two or three attacks, or are liable to sore-throat whenever they come in contact with it; still the rule is constant enough to be depended on for practical purposes.

Mortality.—The fatality of 16,606 cases treated in special hospitals in London from 1886 to 1889 was 1,507, or below 10 per cent.; nor is this rate of fatality less in non-epidemic years, or in seasons when the disease is less prevalent. It varies greatly in different epidemics and in different communities, seldom reaching the high proportion measles sometimes does. Sometimes it passes as lightly as measles often does, but it is mostly much higher. Since many more children have measles and fewer die, while many families escape scarlet fever altogether, and the deaths from it are double those from measles, the proportional fatality of scarlet fever is much greater than for measles. In both diseases many of the milder cases escape notice, and so the rate given may be too high.

Diagnosis.—The sudden illness, with high temperature, quick pulse, and severe nervous symptoms, without previous cough or sneezing, but with sore-throat and tender swelling of the glands at the angles of the jaw, at once point to scarlet fever in a child who has not had it; this is made certain by the early rash.

Diphtheria may come on in the same way, with slight suffusion of face, or more insidiously, but the throat-signs are distinctive. Herpetic sore-throat has a shorter febrile stage, and no rash. The rash of rubella is in raised spots, and less diffused at first; in doubtful cases, perhaps called febrile roseola, albumin is to be looked for in the first fortnight, and desquamation afterwards, before an absolute diagnosis from rubella is formed. Erythema may result from septicæmia, and from mercury, arsenic, sulphur, iodine, bromides, phenazone, santonin, chloral hydrate, salicin, quinine, copaiba, ipecacuanha, belladonna, opium, and oil of turpentine. Rash from the last two drugs may be followed by desquamation.

Prognosis.—Caution is needed in the prognosis of the mildest cases of scarlet fever, as these are not exempt from all the complications of the illness, or the accidents of convalescence.

High initial fever, severe angina, fever rising on the fifth day or persisting beyond the tenth, and great depression, all betoken danger. There is danger from sloughs and secondary suppuration; from cardiac inflammation and its consequences; and from kidney-disease, either at first, or from albuminuria slowly increasing for two or three months; the effects of renal dropsy, under timely care, are of more hopeful prognosis. Family predisposition is to be considered, as well as the age of the patient; and individual susceptibility more than the character of the prevailing epidemic. The temperature has reached 111° F. with recovery, and 115° in a fatal case.

Treatment.—This must have regard to the care of the patient, and the safety of others. All cases must be treated in bed for two or three weeks. A hair mattress, not too thick, is better than a feather bed; and no extra covering is required. Isolated rooms and separate attendance are needed. Carpets and woollen curtains should be removed from the sick room. This must be kept cool and well ventilated by a partly open window and an open fire, but without draughts that come directly on to the patient.

A linen sheet, dipped in carbolic solution, is suspended before the door; a moderately strong solution of permanganate of potassium should stand ready, in which to dip the fingers, or anything used by the patient; a stronger disinfectant is required for the immersion of body-linen when removed, or for the excretions. No medicines will cut short scarlet fever; simple salines, as solution of acetate of ammonium or citrate of potassium, which act slightly on the skin and kidneys, tend to its mitigation if plenty of liquid be given. The best relief is obtained from tepid sponging over the whole body, part at a time, twice in the twenty-four hours, or a tepid bath, and oil or cold-cream used to the skin afterwards. Where the fever is not very high nor the rash intense, a warm bath is comfortable. The hot pack is injurious, most so when the rash is imperfect and the nervous disturbance indicates excessive body-heat. In such cases cold affusion or the cautious use of the wet pack would moderate fever; but these means must be so used as to soothe and not to tire the patient. It is not until after the fever is over that washing with carbolic soap, and detergent baths, with carbolic inunctions, should be practised. During the fever a little solution of permanganate of potassium, or aromatic vinegar, added to the water for sponging the body, or the solution of peroxide of hydrogen, is agreeable and refreshing, neutralising some of the morbid exhalations, if not quite disinfecting them. For this latter purpose strong acetic acid (1 to 5), or carbolic acid (1 to 20 of oil), would be required. Carbolated oil (1 to 40) can be used with advantage from the first, so that the earliest skin-dust may be intercepted. Resorcin mixed with seven to ten parts of vaseline is useful for this purpose.

The throat-symptoms often claim early attention. Swallowing soon becomes easier and the external swelling less after small lumps of ice have been repeatedly held to melt at the back of the mouth; young children can have a teaspoonful of iced water with a morsel of ice in it given frequently; older persons find relief from inhaling steam. A warm compress with cotton-wool over it should be applied round the neck. Puffy swelling over the glands is often removed by fomentation, or by warm linseed poultices constantly renewed. A warm poultice held close up to the ear relieves pain from the tonsil. Mischief within the throat is lessened by taking chlorate of potassium into the mouth, or by the solution of it in spray; a sloughy throat requires chlorinated soda solution, one part to ten of water. Here also the acid chlorine mixture is useful; it is made by dropping strong hydrochloric acid on to chlorate of potassium in a bottle (♏ 3 of the acid and gr. j of the salt to each ounce of capacity), and then adding water to dissolve the liberated chlorine. Large doses of chlorate of potassium are objectionable, as tending to renal irritation. The throat, ear, or nostril may need gentle cleansing and use of the diluted glycerine of borax or of carbolic acid; resorcin, ten grains to the ounce of water, as a spray, or with oil, can be applied. For the control of fever eliminants and depressants are to be avoided; aconite is not needed in the mild cases of fever and sore-throat; it is prejudicial in the more severe forms. The mineral acids moderately control heat-production, and may be given diluted from the first. A tendency on the fifth day to increase of an already high temperature has been checked by the substitution of acids for salines. In all cases with high temperature stronger apyretic remedies are required. Of these, the two most effective and most suitable in scarlet fever are quinine and digitalis. Of the former, two or three doses, on the third or fifth day, at the rate of one grain for every two years of age, reduce fever, and so prevent the worse forms of throat and kidney mischief. If the urine be scanty, or already contain albumin, digitalis is to be preferred; it is of marked benefit where the pulse has been much accelerated in the early stages; and it is specially suited to combine with iron in the later stages of the disease, or with iron and a saline when diuretics are required. The combination of digitalis and quinine in all the graver forms of scarlet fever seems to be specially indicated. Mercuric and other germicides internally are unsafe. The sulpho-carbolate of sodium has been recommended. Salicylate of sodium is not well suited for administration in scarlet fever, as the acid is secreted by the kidneys and may irritate them. When given, it has caused perspiration and reduced the pulse and temperature, but the worst symptoms of bad cases were not lessened by it, while the tendency to rheumatism and to albuminuria is not diminished. It is effective against the rheumatism that follows scarlet fever when there is no kidney-lesion. In most of these cases perchloride of iron in full doses is the best remedy. Acute kidney-congestion should be treated by dry-cupping to the loins, hot epithems round the body, or a warmly packed poultice across the back; a brisk aperient is often most useful at the beginning of this as of other secondary complications. Here free secretion from the bowels is to be favoured by salines, and their diuretic action should be aided by plenty of liquid. Large enemata of hot water tend to relieve the kidneys. Free action of the skin can be obtained by the hot-air bath, or by a hypodermic injection of nitrate of pilocarpine. Two drops of a 5 per cent. solution of the hydrochlorate will answer; the sixth of a grain will produce perspiration in an adult; or one-twentieth of a grain may be given every hour till perspiration ensues. Children require full doses of pilocarpine, up to one-tenth of a grain twice a day in azoturia ; in pale urine there is more urea and less water after some days' use of it. Diarrhœa at the febrile crisis seldom need be checked; care as to ingesta, and warm applications or poultices, perhaps with a little opium externally, suffice for its relief. Great caution is required at all times in the use of any opiates; there are many soothing means which promote sleep without resorting to direct sedatives. Chloral hydrate is not very suitable.

The diet, at first limited to milk and other liquids, may consist also of eggs and beef-tea as soon as more food can be taken, with fish or fowl, and soup with vegetables. Lemon-juice, oranges, or grapes may supplement the vegetable-supply in rheumatic or renal complications. Caution is required as to meat, and even the supply of beef-tea should be limited, while milk can be given *ad libitum*, and eggs may be largely depended on. Alcoholic stimulants are only to be used with great caution. They are apt to excite a return of fever if given early, and may embarrass the restoration of the kidney-function. Still there are many bad cases where a little brandy has to be added to the egg and milk, or where wine must be allowed. Moreover, after high fever a condition like that of heat-exhaustion comes on, with shallow breathing, weak, slow, or irregular pulse, cool surface, restlessness and threatened collapse, where brandy, ammonia, cinchona bark, and even opium may be needed. During convalescence, chill and fatigue must be guarded against. Careful diet is required, and some preparation of iron with meals, or bitters and bark as tonics. We must not advise change of air too soon : three weeks indoors for the disease to cease, and three weeks at home after that, for restoration of health, is the safest rule for all. Warm baths on three or four successive days, with plenty of soap to remove all roughness of skin, and fresh woollen clothing, are required before leaving the sick-room. The hair should be dressed with carbolic oil after washing, or with a mixture of acetic acid, glycerine, and spirit. Infection can be removed from clothes and bedding by stoving all that does not undergo a heat of 212° in washing. The best means of disinfecting the room and what is not easy to remove from it, is by burning sulphur or bisulphide of carbon in it. An ounce and a half of sulphur should be burnt for every 100 cubic feet of clear space. *See* DISINFECTION.

No convalescent should mix with susceptible children until six weeks from the seizure, however slight the attack; if convalescence have been interrupted, or some after-effects of the disease remain, this interval has to be two or three weeks longer. Those much with the sick should wash their hands after assisting the patient, and change their outer dress on leaving the room. A solution of salicylic acid with borax and glycerine promises to be of some use in clearing infectious particles from the throat, and so may act as a preventive against one mode of infection. No true prophylactic is known.

WILLIAM SQUIRE.

SCHANDAU, in Saxony. — Chalybeate waters. *See* MINERAL WATERS.

SCHINZNACH, in Switzerland.— Sulphur waters. *See* MINERAL WATERS.

SCHLANGENBAD, in Germany.— Simple thermal waters. *See* MINERAL WATERS.

SCHMECKS (Tatra-Füred, Tatra-bad), in Hungary (Alt-Schmecks and Neu-Schmecks, and Unter-Schmecks).—Acidulated alkaline waters, and climatic health-resort. *See* MINERAL WATERS.

SCHÜLS.—*See* TARASP-SCHÜLS.

SCHWALBACH. — *See* LANGEN-SCHWALBACH ; and MINERAL WATERS.

SCIATICA. — SYNON. : Fr. *Névralgie, Sciatique* ; Ger. *Hüftweh.*

DEFINITION.—Neuralgia in the district of the sciatic nerve.

Sciatica is signalised by paroxysmal pain in any or all of the following localities : the buttock; the back of the thigh; the knee ; the front, back, and outside of the leg ; and the whole foot except its inner border. The condition is frequently of peripheral origin, and is then dependent on inflammation of the nerve-trunk. Or it may arise independently, to all appearance, of any local cause in the nerve itself, and is then probably caused by some impairment of nutrition of a nerve-centre. As the diagnosis of interstitial neuritis from neuralgia is as yet not certainly differentiated, the two conditions will be considered together.

ÆTIOLOGY.—*Predisposing causes.* — The predisposing causes of sciatica are arterial degeneration; anæmia; the rheumatic and gouty diatheses ; the toxic influences of malaria, chronic alcoholism, syphilis, and lead ; inherited neurotic disposition; fatigue ; and a damp and cold climate.

Exciting causes.—These include exposure of the limb to a draught of cold air for some long time, which is a common source of the affection ; sitting on a cold or damp seat ; over-walking ; strains ; concussion of the spine ; the encroachment of morbid growths ; blows upon or wounds of the nerve-trunk ; malignant and other tumours of the pelvis ; disease of the vertebræ or pelvic bones ; the pressure of the gravid uterus ; rheumatic or gouty inflammation of the sciatic nerve, or of one or other of its branches; syphilitic periostitis, causing a swelling which presses upon the trunk or some branch of the sciatic nerve; and a gumma in the sheath of the nerve.

In chronic rheumatic arthritis of the hip-joint the sciatic nerve may sometimes be felt to have hard, knotty swellings upon it, apparently arising from a chronic perineuritis. This is associated with very obstinate sciatica.

Sciatica affects especially the middle age of life—from forty to fifty years, is rare in youth, and but seldom commences in elderly persons. Venereal excesses have a closer connexion with sciatica than with any other form of neuralgia.

The violent manipulation of a professional rubber, employed to treat a dull aching in the sciatic region, may bring about acute sciatica.

Anatomical Characters.—Nothing certain is as yet known of the seat of the lesion in cases of neuralgia proper manifested in the district of the sciatic nerves.

The few changes which have been observed *post mortem* in cases of sciatica have been in the direction of thickening of the sheath of the nerve, the result of inflammation. It has happened, however, that in cases which during life have been supposed to be examples of neuritis, no trace of the inflammatory process has been found in the nerve itself.

Symptoms.—After more or less of vague discomfort in the affected limb, deadness, tingling, stiffness, or some such abnormal sensation, pain occurs in some part of the district already indicated. This is variously spoken of as shooting, darting, screwing, tingling, or burning; and the sufferer will often map out with precision the course of various branches of the nerve as the seat of his distress. Sometimes the leg is described as being numbed, or as if it were going to burst. Occasionally the feeling resembles a very faint shock of a battery. As is characteristic of neuralgia generally, the pain may be apparently spontaneous in origin, whilst in certain cases it is also liable to be aggravated by movement, but in no case is it *only* excited when muscular contraction takes place. It may either occur in paroxysms, with intervals of complete immunity varying from minutes to hours; or there may be more or less continuous suffering, with frequent and violent exacerbations. Throbbings or pulsations of the pain are often described. It is not, as a rule, accompanied by pyrexia. When the pain is at its height, a powerlessness of the muscles of the limbs is apt to be experienced, and this not simply on account of the distress of moving, but from an actual paresis, dependent possibly upon a depressing influence communicated to the motor centres; or, should the condition be one of neuritis, due to obstruction of nervous impulses by inflammatory products. From a like cause affecting the vaso-motor fibres the limb will feel cold, not only subjectively, but to the touch.

Tender points may be met with in all, but more often in some few only, of the following situations: The posterior inferior spine of the ilium; about the middle of the dorsum of the ilium; about midway between the tuber ischii and trochanter major; the fold of the buttock; head of the fibula; behind each malleolus; in the popliteal space. There is commonly some cutaneous anæsthesia in some part of the limb, and sometimes replacing this there will be found patches of skin which are hyperalgesic. The tactile sense proper is lowered at these points, whilst the sense of temperature, especially for heat, is often heightened. At the same place a weak voltaic current is felt as extremely and quite abnormally painful. Cramp of the calf muscles is common. It is often impossible for the patient to sit, owing to the tenderness of the nerve-trunk near the tuber ischii. The act of putting on a stocking, stooping, or sneezing gives rise to great pain.

There are great differences in the course and character of the affection. In some persons the disease from the first presents the characters of a chronic affection. There is never pain sufficient, for example, to prevent sleep, and it may not arrive at a degree of severity to interfere much with locomotion. Indeed the sufferer may experience a certain amount of relief from moving about. But the patient is worn by a more or less constant aching in the district of the sciatic nerve, which becomes especially marked after long sitting, as on a railway journey, and most of all if the seat be somewhat hard. Fatigue of body and mental worry have great effect, in such cases, in intensifying the symptoms, which, on the other hand, may almost entirely disappear in circumstances favourable to improved health and mental exhilaration. Sciatica of this type is prone to attack the middle-aged, to be permanent, and to acquire additional intensity with advancing years. In contrast with such cases are those which from the first exhibit the characteristics of an acute affection. The pain is so agonising that no posture affords relief, sleep is impossible, the general health greatly suffers, and the patient is placed completely *hors de combat*. The disease may last for weeks or months without material intermission, the patient being confined helplessly to his bed; and when at length the symptoms subside, the period of convalescence may be very prolonged. Or after some weeks of acute suffering, improvement may take place, to be followed only by a relapse, which is even more violent than the original attack.

Although the recumbent position is commonly that which is least irksome to the patient, yet it will happen that after a night passed in sleep attempts to move the affected limb cause it to be more painful than after walking, and there is a distressing stiffness about it.

In some persons the disease attacks once, in a very severe form, it may be at a comparatively early period of life, and never recurs. In many, however, it tends to recurrence, and with such persistence that the patient will speak of 'his sciatica' as a companion which is always present, though occasionally for a term out of sight. Or it may alternate with attacks of typical neuralgia in other parts of the body; or be replaced by various functional disorders of the nervous system, accompanying an excess of uric acid in the urine.

The disease may be accompanied by considerable muscular atrophy of the limb, and a quasi-paralytic condition, which, though capable of improvement, may, exceptionally, leave the patient more or less lame for the rest of his life. Much more often the wasting which has accompanied the acute symptoms of the disease gradually ceases as these subside, and during the somewhat prolonged convalescence the limb is restored to its original size, and the lameness is no longer observed. Sciatica often follows lumbago. In some cases years may elapse between the attacks, but much more frequently it is a question of a few days or weeks.

Diagnosis.—There are three conditions of the muscular system which are apt to be confounded with sciatica: (1) Myalgia from over-exertion of the flexor muscles at the back of the thigh. Here the pain will be found at the points of insertion of the muscles, and is only felt during their action. (2) Rheumatism in the muscles from exposure to cold. Here, again, the pain is not spontaneous, as in sciatic neuralgia, but is always dependent on muscular action. (3) A low inflammation of the loose bursal tissue which separates the large muscles of the thigh, brought about, it is probable, by the presence of some morbid material conveyed by the lymphatic vessels with which the spaces are in direct communication. Uric acid and pus are especially liable to cause this affection. Sacroiliac disease may be distinguished by its always occurring in youth; by the pain being confined to the sacral neighbourhood; and by the limb being lengthened at an early period. From hip-joint disease, especially in the slow insidious form which it sometimes takes, sciatica is not always distinguished with facility. The paroxysmal character of the pain, presence of tender points, absence of result from forcible movement of the joint, and absence of characteristic position or shortening of the limb, will best serve for diagnosis. The lameness in sciatica may lead to the idea of paraplegia, from which the disease may be distinguished by the perfect integrity of the other limb, as well as by the paroxysmal pains, tender points, and the history showing that the powerlessness was secondary to the pain. From the darting pains in the thigh consequent on renal calculus, sciatica may be easily distinguished by careful examination.

The affection may be limited to a single branch, and when this is the terminal portion of the anterior tibial nerve supplying the big toe, there is a *primâ facie* resemblance to gout. It may be distinguished from this, however, by noting the absence of heat, swelling, redness, or pain on moving the joint; and the presence of a small spot, at which alone pressure is extremely painful.

Syphilitic periostitis, with inflammation of the sheath of the sciatic, may be distinguished from malignant disease by the effect of large doses of iodide of potassium. Sciatica may be distinguished from the lightning-like pains of tabes dorsalis by the presence of the patellar tendon-reflex. Should the anterior crural nerve be affected with neuritis coincidently with the great sciatic, the knee-jerk may be temporarily lost. It is well to remember that sciatica, properly so called, is an unilateral affection. Should it be described as affecting *both* lower extremities coincidentally, examination will show that the supposed sciatica is either tabes dorsalis, or neuritis of the cauda equina, of diathetic origin, or secondary to the presence of a morbid growth. Or it may be due to diabetes mellitus, alcohol, or syphilis.

Treatment.—This should be constitutional as well as local. Gout, rheumatism, syphilis, malaria—if inquiry show that either of these conditions lies at the base of the disease—will need the treatment appropriate to each. Against a gouty or rheumatic basis the diet should be spare in meat, with milk—all stimulants being as a rule avoided. Bicarbonate of potassium in effervescence, citrate of lithium, iodide of potassium, and colchicum will be the drugs most likely to afford relief. If the gouty character be very pronounced, it will be well to give salicylate of sodium in twenty- or thirty-grain doses, dissolved in half a tumbler of water, every three or four hours. The bowels should be freely acted upon with mercurial alteratives and Carlsbad salt. If syphilis be suspected, iodide of potassium or of sodium should be given, in doses of from ten to thirty grains three times a day or oftener.

Quinine, in doses of five grains, or arsenic may be employed if there be reason to believe that there is a malarious taint.

The recumbent position is very necessary in all cases of any severity; and, should the distress be very great indeed, it is a good plan to put the patient on a water mattress.

Or the affected limb may be preserved from movement by the application of a long splint, kept in position by a flannel bandage, changed daily. Sometimes the rapidly repeated application of very hot linseed-meal poultices will give much relief. Occasionally, if the pain and tenderness be very exquisite, and the patient's age and condition do not contra-indicate it, the application of a few leeches to the upper and back part of the thigh is useful. The hypodermic injection of morphine gives, of all remedies, the most speedy relief; but it is a hazardous remedy for the patient, who is very apt to acquire the morphine habit. It is best to employ a solution of one grain in thirty minims, and to inject at first three minims twice in the twenty-four hours, if necessary. The dose may be increased by one minim at a time if it be found desirable; but it is rarely necessary, except in cases of malignant disease, to exceed eight minims of such a solution. The dose and frequency should be diminished as relief is obtained. The hypodermic injection of hydrochlorate of cocaine is sometimes very useful. It should be performed at the seat of pain, and endeavour made to thrust the point of the syringe into the spot of greatest tenderness. The application may be repeated, if necessary, two or three times a day, in doses of gr. $\frac{1}{4}$. The bowels should be kept thoroughly relieved. Flying blisters, not larger than a five-shilling piece, one following another as it heals, not on the same but on a closely adjoining part of the skin, may usually be applied with much advantage. Even in cases dependent upon malignant disease they will often give relief for a time. Spongiopiline wrung out of boiling water, and sprinkled with the compound mustard liniment, makes a good counter-irritant, and will sometimes take the place of blistering.

The continuous galvanic current is occasionally palliative. From twenty to forty cells may be employed; and whilst one rheophore is applied to the sacro-iliac synchondrosis, the other is dropped into a tub of salt water, in which the patient places his foot. The strength should be arrived at gradually, and the application continued for ten minutes at a time. Then, without removing the rheophores, the strength of the current must be gradually reduced to zero. Without this precaution a shock will be given, which is undesirable. The electrical application should not be employed during the very acute stage, but rather in cases of moderate severity, or where the most formidable suffering has subsided. The current may be conveyed into a bath if preferred. One rheophore is allowed to fall into the bath, the other is held by the patient above the level of the water, which should be of a temperature of 95° F., and should contain some salt. In some cases, after acute symptoms have subsided, good has appeared to be done by enveloping the limb in a flannel bandage, over the folds of which sulphur is sprinkled. In other cases it is said that oil of turpentine taken internally has cured where other remedies have failed. In obstinate cases the sheath of the nerve may be punctured in a few places with a sharp needle. *See* ACUPUNCTURE.

The baths of Buxton, Wiesbaden, Wildbad, Royat, and Gastein have been found useful in treating sciatica; and artificial hot-air or vapour baths may be beneficial in some instances.

The sciatic nerve has been cut down upon and stretched with advantage in several cases of confirmed sciatica. *See* NERVES, Diseases of.

T. BUZZARD.

SCIRRHUS (*σκιρρός*, hard).—A hard glandular, cancerous tumour. *See* CANCER; and TUMOURS.

SCLEREMA NEONATORUM (*σκληρός*, hard; and *neonatorum*, of the newly born).—SYNON.: Skin-bound Disease.

DEFINITION.—A congenital affection, or one appearing in early infancy, characterised by a stretched and tense condition of the skin.

DESCRIPTION.—The disease usually commences on the lower extremities, and gradually involves the entire surface. The skin becomes glossy-looking and of a yellowish or reddish colour, but it may be mottled. To the touch it is firm and rigid, like bacon-rind, and cannot be pinched up between the fingers. The surface is cold, feeling like that of a half-frozen corpse. The infant is, in fact, skin-bound; all movement becomes impossible; and the features remain fixed and staring. Death within a short period is the ordinary termination, recovery rarely occurring spontaneously.

The disease is usually associated with affections of the respiratory and circulatory systems, and has been observed in connexion apparently with congenital syphilis.

Microscopical observation has thrown but little light on the nature of sclerema neonatorum. There is a general dry and thinned condition of the skin, but the disease seems to differ from the scleroderma of adults in the absence of increased fibrous tissue, a histological character which is peculiar to the latter affection.

TREATMENT.—No treatment appears to avail in this disease, but that usually employed for syphilitic taint has been suggested.

ALFRED SANGSTER.

SCLERODERMA (*σκληρός*, hard; and *δέρμα*, the skin).—SYNON.: Addison's Keloid; Morphœa.

DEFINITION.—A chronic disease of the skin, circumscribed or diffuse, in which an excess of fibrous tissue leads to hardness, change of colour, and by contraction to stiffness and immobility.

Ætiology.—Scleroderma is a rare disease of the skin, which occurs at all periods of life, but more frequently in young adults and in middle-age. It is more frequent in women than in men. Little is known as to its causation; but rheumatism, especially of the joints, has been known to precede the attacks, and it has sometimes followed exposure to wet and cold. It attacks persons otherwise in good health. The circumscribed form sometimes follows the course of cutaneous nerves, and for this and other reasons it is regarded by some authors as essentially a tropho-neurosis. So far, however, the correctness of this view cannot be considered as having been definitely established. In some cases the circumscribed form has been referred to irritation caused by blows, blisters, pressure, and other causes.

Anatomical Characters.—The essential structural changes consist in an increased formation of connective tissue, and a perivascular exudation of the cellular and plastic substances, which is always associated with new growth of this element. The number of elastic fibres appears increased in certain parts of the skin. The formation of new fibrous tissue takes place not only in the corium, but in the panniculus adiposus, and extends to the deep fascia and periosteum. In its overgrowth the fat disappears, and the smooth muscular fibres appear to be hypertrophied. The papillary body is rendered more dense than usual by bands of connective tissue, and there is an increase of pigment both in it and in the rete. Otherwise the epidermis is unaltered. In the early stage the effusion leads to hypertrophy of the cutis, but later the contraction of the fibrous tissue causes atrophy of the integument and narrowing of the blood-vessels. At first the sebaceous and sweat glands are unchanged, but they are afterwards atrophied. Sometimes there appears to be a dilatation of the sweat-glands in the early stage. In the extreme atrophic stage of diffuse scleroderma the compression leads to more or less disorganisation of ligamentous tissues.

Description.—Scleroderma is found in two well-marked forms—*diffuse* and *circumscribed*, which in their typical development differ so much from each other in appearance that they were formerly considered to be distinct diseases, the circumscribed form being known and usually described as *morphœa*. Transition forms are, however, sufficiently common to establish the nosological identity of the two varieties of the affection.

Circumscribed scleroderma. — A developed patch of circumscribed scleroderma is usually characterised by a rounded area of white or yellowish-white skin, which in some cases looks like smooth ivory. Around this patch there is a yellowish or brownish pigmentation. The white surface is usually firm to the touch, brawny, and difficult to pinch between the fingers. The sensibility is unimpaired. The earliest stage in the development of such an area is characterised by hyperæmia, which is manifested by congestion and small dilated blood-vessels shining through the surface. The disease may begin in one or more such isolated patches, which, as they become circumscribed, are surrounded by a well-marked lilac border of minute blood-vessels. Such a patch may remain for months or years without much change, or it may undergo involution, which sometimes takes place quickly, leaving the skin healthy; or, on the other hand, it may become atrophic, the skin becoming thin, parchment-like, and cicatricial.

These patches occur in various parts of the body, but most frequently on the neck, face, chest, trunk, arms, and thighs. They are unsymmetrical. There is a sufficient number of cases on record in which the changes in the cutis have followed the track of certain nerves so as to indicate a certain relation to nerve-distribution. The affected skin does not sweat. There are usually no subjective symptoms, but there may be itching, or tingling, occasionally even pain. Circumscribed scleroderma sometimes occurs in the form of bands, which are usually depressed below the surface and more or less adherent, and sometimes extend for a considerable length.

Diffuse scleroderma.—This occurs on different parts of the body, but more usually in its upper half. It may be limited to certain parts, the skin between them remaining normal, or it may be spread over large parts of the integument, such as the back, abdomen, limbs, and face. It may develop after a short period of malaise, but as a rule the process is at the beginning not observed by the patient, his attention being first called to it by stiffness of the skin; or pigmentation may be early observed. Stiffness is usually first felt about the neck, chest, shoulders, or arms, and spreads with more or less rapidity towards the limbs, the border being usually ill-defined, although to some extent perceptible to the touch. Doughy infiltration or erythema may precede the induration. As the skin becomes hard and stiff, mobility is affected, the joints becoming fixed and the face immobile. The patient cannot open his mouth widely, and the affected surface of the body has been compared to that of a frozen corpse, without, however, being cold. The skin does not pit, and cannot be pinched up. The patient is usually hidebound. The respiration is impaired, the breasts flattened, the limbs and fingers more or less flexed. The disease may even extend to the mucous membranes. The contraction of the skin leads to the disappearance of wrinkles, old persons looking younger than their years. The surface is generally smooth and shining, but sometimes dry and desquamating, the skin being pale, whitish, and waxy. The disease may reach its full extent in a period of weeks or months.

The temperature of the affected skin is on the whole normal, sometimes being slightly above and sometimes below the average. Pressure is felt, and the tactile sensibility is usually unaffected, but sometimes weakened. Secretion of sweat may be diminished. The sebaceous secretion is usually normal. The nutrition of the affected skin being impaired, it is liable to inflammation and ulceration from the ordinary sources of irritation. The limbs, from compression of the continually contracting skin, gradually become smaller. The palms and soles are rarely affected.

The course of the disease varies considerably. In the early stages a spontaneous cure may occur, involution sometimes taking place at one part while new development is showing itself at another. When shrinking and atrophy have proceeded to an extreme extent life becomes threatened. The general health in the earlier stages of the disease does not seem to be notably affected; but as atrophy and shrinking proceed, the patient falls into a condition of marasmus, and death occurs from intercurrent complications of various kinds. Kaposi refers to a case of Strassmann's, which had lasted thirty-one years without the health being materially affected.

Diagnosis.—Scleroderma is not likely to be confounded with other diseases characterised by hypertrophy and œdema. The tension, rigidity, hardness, and shrinking of the diffuse form are distinctive; in the circumscribed form the pigmented and hyperæmic zone surrounding the waxy patches distinguishes it from leprosy, and vitiligo. In anæsthetic leprosy, anæsthesia is characteristic. In atrophic conditions there is a history of a previous hypertrophic stage.

Prognosis.—Recovery may take place so long as the atrophic stage has not set in, improvement showing itself within a period of weeks or years. In the atrophic stage the prognosis is unfavourable, death being due to complications of various kinds.

Treatment.—Tonics, such as iron, quinine, vegetable bitters, cod-liver oil, and arsenic, are believed to assist a tendency to recovery when it is present. Baths, vapour-baths, hot packing, change of air, emollients, such as simple ointments, glycerine, or vaseline, and massage, are recommended. The continuous current applied to the affected skin and sympathetic nerve is believed by some authorities to be useful. It is recognised that iodine and mercurials have no value. Warm clothing and general protection against cold are indispensable. G. Thin.

SCLEROMA (σκληρός, hard).—A term signifying a hardening of the softer tissues of the body under the influence of disease. *See* Sclerema Neonatorum; Scleroderma; and Sclerosis.

SCLEROSIS (σκληρός, hard).—Synon.: Fr. *Sclérose*; Ger. *Sclerosis.*

Definition.—A state of induration, hardness, or toughness. The term is also applied to the process by which such a state is brought about in organs and tissues.

Induration of organs has long been recognised; and before the microscope came into ordinary use this term, as well as its correlative, 'softening,' was very commonly employed by pathologists in their descriptions of certain morbid conditions found in different organs of the body.

Since Laennec, under the influence of a mistaken impression, first gave the name 'cirrhosis of the liver' to one of the common diseases of that organ associated with induration, it has gradually become more and more common to apply this name 'cirrhosis' to analogous conditions of induration in other organs. Hence the word 'cirrhosis,' and the phrase 'cirrhotic process,' have come to be used as the equivalents of 'induration' and 'process of induration,' although the Greek word from which cirrhosis is derived (κιρρός, yellow, or tawny) has a totally different signification. *See* Cirrhosis.

In recent times a limitation in the use of this phrase has sprung up. The real nature of indurations occurring in parts of the central nervous system, as well as the frequency of such processes, were recognised much later than the period above referred to. Yet, if we make allowance for the peculiarities in the texture of the brain and spinal cord, and remember that even its connective tissue (neuroglia) has a modified constitution as compared with that of other organs, it is evident that these indurations of brain and spinal cord are due to so-called 'cirrhotic processes.' Such processes, in fact, occur in them with great frequency, and constitute the anatomical basis of several distinct diseases, such as locomotor ataxy, spasmodic spinal paralysis, and cerebro-spinal sclerosis. Only it so happens that the old and etymologically unsuitable name has never been applied to them. It has always been common to speak of such an indurating process, as it occurs in the brain or in the spinal cord, by another word of similar import derived from the Greek language—that is, as a 'sclerosing process,' and of the pathological state itself as one of 'sclerosis.' This anatomical condition and the proper treatment of it will be found fully treated of in other parts of this work. *See* Insanity, Morbid Anatomy of; and Spinal Cord, Special Diseases of.

H. Charlton Bastian.

SCLEROSIS, Cerebro-Spinal
SCLEROSIS, Spinal }.—
See Spinal Cord, Special Diseases of: 18. Multiple Sclerosis of the Spinal Cord.

SCLEROSTOMA (*σκληρός*, hard; and *στόμα*, a mouth).—A synonym for ankylostoma duodenale. *See* Entozoa.

SCLEROTIC, Diseases of.—*See* Eye, and its Appendages, Diseases of.

SCORBUTUS.—A synonym for scurvy. *See* Scurvy.

SCRIVENER'S PALSY.—A synonym for writer's cramp. *See* Writer's Cramp.

SCROFULA (*scrofa*, a sow).—Synon.: Fr. *Scrofule*; Ger. *Scrofeln.*—The term 'scrofula' was used in times past for a large number of ailments believed to possess certain characteristics in common. It is significant that the word itself owes its origin to the swelling of the neck so often seen in the subjects of this disease. Glandular scrofula was, therefore, originally, and has ever been the type of what is scrofulous. For this reason we may commence by considering the topic of scrofulous lymphatic glands, or struma vera.

Anatomical Characters. — Matthew Baillie writes thus: 'The most common morbid affection of the absorbent glands is scrofula. In this case the glands are frequently a good deal enlarged, and sometimes feel a little softer to the touch than in a healthy state. When cut into, they sometimes exhibit very much the natural appearance; but it is more common to find that some of them contain a white, soft, cheesy matter, mixed with a thick pus: this is the most decided mark of a scrofulous affection.'

But this cheesy change is a late stage of the strumous affection. Scrofulous glands, which are only potentially, but not actually, cheesy, present to the naked eye very much the natural appearance, as Baillie says. If we take a chain of lymphatic glands, all somewhat enlarged, but only some of them cheesy, we should expect to find the earlier stage of the strumous lesion in the glands which look most natural. These apparently natural lymphatic glands, therefore, are those which we choose for examination first of all.

Virchow taught that the primitive strumous lesion consisted in a simple hyperplasia of the gland-tissue. But to Schüppel (1871) belongs the merit of having proved that a scrofulous gland is indeed a tuberculous gland. In the earlier stage of the lesion, the gland is studded with microscopic tubercles, possessing the usual characters. And the subsequent changes, cheesy and other, which the gland undergoes, are due to changes in these tubercles. *See* Tubercle.

Tubercle bacilli have been found in scrofulous lymphatic glands as in all other tubercular lesions, and experiment shows that inoculation of portions of the diseased glands produces tuberculosis in the lower animals indistinguishable from that resulting from infection with any other tuberculous material. The view expressed in the first issue of this work that glandular scrofula is a truly tuberculous disease has therefore been amply confirmed. The tubercle bacilli may be derived from a tubercular affection of the skin or mucous membrane, the lymphatic vessels of which enter the affected gland, or the microbe may pass into the lymph spaces through accidental abrasion of the skin, or through an unbroken mucous surface, such as that of the mouth, tonsil, or nose. That is to say, a primary tubercular lesion of some mucous or cutaneous district is not essential for the transmission of the bacilli to the neighbouring glands. This is well seen in the common case of primary tuberculosis of the bronchial and mesenteric glands without disease of the bronchial or intestinal mucous membrane. The tuberculous process may remain limited to the gland, or it may prove the starting-point of general tuberculosis. In the first case, the caseous material becomes encapsulated and often calcified, or suppuration may occur and the remnants of the diseased gland may be discharged. In the other case, the bacilli may pass through the gland into the efferent lymphatics, and reach the general circulation through the thoracic duct, and thus disseminate the disease throughout the body.

Symptoms.—In the living person strumous lymphadenitis may be distinguished from what we may call genuine lymphadenitis. The chief character of the scrofulous disease consists in its obstinacy, intractability, pertinacity. Once enlarged, the strumous gland remains enlarged for a long time. The reason of this lies in the nature of the tuberculous inflammation and its products. A genuine lymphadenitis, in a healthy person, will resolve, suppurate, or organise in a short time. In struma vera, resolution, suppuration, and organisation take place very slowly, even when they take place at all. Commonly the inflammatory products remain where they were produced, inert and passive, and sooner or later undergo the cheesy change. Hence the intractability of strumous lymphadenitis.

In many instances of persistent glandular enlargement associated with chronic eczema or dermatitis, the epithet 'scrofulous,' so freely used in former times, is not justified, as the disease, though chronic and intractable, is not actually tuberculous.

Other Scrofulous Affections.—In the case of the skin, scrofuloderma, a condition mostly secondary to suppurating caseous lymphatic glands, unquestionably merits the term 'scrofulous.' Again, lupus seems to be a chronic tuberculosis of the skin. But most of the diseases styled *scrofulides* by the French school are not tuberculous. A persistent swelling or chronic œdema of the subcutaneous tissue of the lips and eyelids is not uncommon in 'scrofulous' persons, but this condition cannot be regarded as characteristic. Turning now to the mucous membranes, a certain number of cases of otitis, rhinitis, and similar affections, can be shown to be tuberculous, but many chronic inflammations, from their obstinate nature, are erroneously ascribed to the same cause. Most, if not all, of the scrofulous diseases of bones, joints, and viscera, including cold abscesses, are tuberculous. For further information on this point the reader should consult the appropriate articles. It may be doubted whether the term 'scrofula' or 'struma' should be retained, seeing that from our present standpoint it is only applicable to tuberculous affections. If used in its former loose sense, to include tuberculous and non-tuberculous disorders, it is altogether misleading and objectionable.

The Scrofulous Diathesis. — After what has been said above concerning the relations of scrofula and tuberculosis, it is unnecessary to discuss the question of a scrofulous diathesis separately; and on this subject, as well as on the subjects of the ætiology and pathology of scrofula, reference should be made to the article on TUBERCLE.

TREATMENT.—The treatment of scrofula is preventive and curative; and relates, moreover, to the strumous disposition and the dependent structural lesions. The prevention of the disposition clearly consists in avoiding the predisposing and exciting causes thereof. Its cure is to be sought in carrying out the rules of health: fresh air and sunlight are especially needful (*see* PERSONAL HEALTH; and TUBERCLE). Iodine, once thought to be a specific, has much sunk in repute; cod-liver oil ought perhaps to be reckoned a food rather than a drug. The cure of the local lesions, by these or by surgical means, does not only relate to the sundry lesions themselves, but is also a means of preventing further development of the disease. Cure and prevention thus go hand in hand. The treatment of the primary local inflammations will be found in the appropriate articles. With regard to the glandular abscesses, the chief source of general tubercular infection, it would seem to be more reasonable to favour an outward discharge of the matter, than to strive to promote its absorption.

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SCURF.—A popular name for the bran-like exfoliation which forms at the roots of the hair. It is composed of the normal desquamation of the epidermis of the scalp, with the addition of the epithelial exuviæ thrown off by the hair-follicles. *See* PITYRIASIS.

SCURVY.—SYNON.: Scorbutus; Fr. *Scorbut*; Ger. *Scharbock.*

DEFINITION.—Scurvy is characterised clinically by intense general debility; sponginess and swelling of the gums; ecchymoses, closely resembling bruises, about the thighs and legs; a brawny hardness about the flexures of the larger joints, and sometimes a contraction of the muscles of the calves; pearly conjunctivæ; and a sallow aspect somewhat akin to mild jaundice.

From a pathological point of view the disease is characterised by effusion of a semi-organisable fibrinous material in the tissues of the gums, between the striæ of the muscles of the thighs, legs, and sometimes (but comparatively seldom) of the arms, and also between the periosteum and the bones of the extremities, and occasionally of the ribs; ecchymoses sometimes found about the thoracic and abdominal aortæ and the alimentary canal; and a generally blanched condition of all the tissues.

ÆTIOLOGY.—Scurvy is, in an eminent degree, cosmopolitan. It may prevail in a mild or severe, an intermittent or endemic form, in any latitude, in any country, or among any variety of the human race, inasmuch as the predisposing and exciting causes may exist anywhere under certain circumstances. War, famine, shipwreck, or any other accident or exigency that deprives human beings for a length of time of fresh vegetable food is sufficient to introduce scurvy into a community. Although very vaguely described by Hippocrates and other early writers, there is no doubt that in semi-civilised and savage countries scurvy was endemic. Most military historians, who have chronicled the sanitary circumstances of armies from the thirteenth century to the date of the last American war, speak of its ravages, and in the early months of the Crimean War the French lost more men by scurvy than by the guns of the enemy. It has also from the earliest times been a chief foe to sailors; and until the beginning of the seventeenth century, it constituted a formidable item in the mortality list of the navy in this as in other countries. In the spring of 1840 an outbreak of the disease occurred among the prisoners at the Millbank Penitentiary, and was confined exclusively to the military sections of the inmates, whose diet differed in one important respect from that of the other convicts. The last extensive outbreak on land, other than those that have arisen in consequence of war, occurred in Ireland during the potato famine in 1847, when the inhabitants suffered severely. Since, however, the prophylactic properties of a vegetable diet have been understood, scurvy, except in times of war, has—unless under very exceptional and always preventable conditions—ceased to assume formidable proportions either ashore or afloat. It is indeed, in civilised communities, very rarely found on land. It is almost extinct in the Royal Navy, except the outbreak in the last Arctic expedition under Sir George Nares; owing to the introduction of lime- and lemon-juice, and also to the greater variety in the scales of diet. During the last eight years it has diminished in the British Mercantile Marine by from 70 to 80 per cent., in consequence of legislative enactments that secure a proper quantity and quality of antiscorbutics to the crews of all long-voyage ships. Cases of the disease are still seen occasionally at the Seamen's Hospital at Greenwich, usually associated with some other disease, as dysentery, ague, &c.; but in some instances clearly caused by carelessness, either on the part of the captain in serving, or on the part of the crew in not taking, the lime-juice provided.

PATHOLOGY AND ANATOMICAL CHARACTERS. Although the ætiology of scurvy is so well understood, yet we are still in ignorance of the precise nature of the alterations of the blood and tissues which precede and accompany the development of the disease. The most important contributions hitherto made to our knowledge of the pathology of scurvy are those of the late Mr. George Busk and Sir Alfred Garrod. The former, in a series of analyses made of the blood drawn from scorbutic patients, showed that there was a considerable diminution of the red blood-corpuscles, an increase in the amount of fibrin and albumen, and no decrease in the amount of potassium salts. Sir Alfred Garrod observed that in scorbutic diets potassium existed in smaller quantities than in antiscorbutic ones, and was led to determine the amount of that substance in the blood and urine of a patient suffering from scurvy, and he found it considerably diminished. From this observation, he brought forward the theory that scurvy depended upon a deficiency of potassium in the system. The fact that potassium is diminished in the urine of patients suffering from scurvy has been confirmed by Dr. Ralfe and others. But it is doubtful whether the disease is produced by a deficiency of that base in the system, since the administration of large quantities of beef-tea, containing more potassium than in the ordinary antiscorbutic dietary of the Seamen's Hospital, fails to exercise a curative effect, and it is not till the patient obtains lime-juice or potato that he recovers. Dr. Buzzard considers that, although the organic acids and potassium separately do not represent the requisite material, it is to be found in the chemical combination of the acid and the base. The writer, from observations founded on the effect which the withdrawal, for a considerable period, of all fresh succulent vegetables and fruits has on the urine of healthy persons, and from the analyses of urines from patients suffering from the disease, has concluded that the 'primary alterations in scurvy seem to depend on a general alteration between the various acids, inorganic as well as organic, and the bases found in the blood, by which (*a*) the neutral salts, such as the chlorides, are either increased relatively at the expense of the alkaline salts; or (*b*) that these alkaline salts are absolutely decreased. This condition produces diminution of the normal alkalinity of the blood; and he suggests that this diminution produces the same results in scurvy patients as happens in animals when attempts are made to reduce the alkalinity of the body (either by injecting acids into the blood or feeding with acid salts), namely, dissolution of the blood-corpuscles, ecchymoses and blood-stains on mucous surfaces, and fatty degeneration of the muscles of the heart, the muscles generally, and the secreting cells of the liver and kidney.'

The most marked morbid changes of scurvy are the œdematous, spongy, and occasionally ulcerated gums; the bruised-like condition of the legs; and the brawny hardness, confined usually to the gastrocnemius and hamstring muscles. On cutting these across, tough fibrinous effusions are found packed between the muscular striæ, giving the cut surface a streaky appearance. If the anterior surface of the tibia be examined, the same kind of effusion will be often found between the periosteum and the bone. It would appear that the effusion is due, not to the degenerated condition of the vessels, but to a chemical alteration of the blood. Also hæmorrhagic effusions are sometimes found beneath the periosteum, or between the epiphyses of the larger joints, especially when scurvy has proved fatal in children.

In severe cases the ribs will sometimes be found detached from the cartilages, and old fractures occasionally become disunited. Beyond a general anæmic condition, and occasional ecchymotic spots about the pleura and pericardium, the contents of the thorax present no special appearances. In examining the abdominal viscera, attention should be directed to the spleen, which is usually friable, and often rotten and pulpy; to the external coats of the intestines, in which patches of effusion will frequently be found; and to the mucous coat of the large intestine, which, if, as is frequently the case, the disease be complicated with dysentery, will be studded with ulcers of varying depth, which have, however, entirely lost their dysenteric character, and become ragged along the edges, ill-defined, but not, as a rule, very much excavated. The body is not always badly nourished, and the cheeks are usually puffy on account of the swollen gums; but local or general dropsy is seldom present.

SYMPTOMS.—The most striking features of

scurvy are a complexion of sallow, dull leaden hue, analogous only to that of a patient who has been for a long time subject to attacks of some form of remittent or intermittent fever, or to that of a person recovering from jaundice; pearly-white conjunctivæ; puffy and sometimes bloated cheeks; gums spongy, bluish-red in colour, swollen sometimes to such an extent as to hide the teeth both in front and behind, and tending to bleed; teeth more or less loose, some already lost; tongue clean and pale; no special characteristic about trunk and upper limbs (though the latter are now and then slightly ecchymosed); shortness of breath, but no other chest complication; no abdominal tenderness or anything abnormal as to the functions of the abdominal organs; thighs and legs usually presenting a more or less bruised appearance, particularly just above and below the knees; brawny indurations of the hams and calves of the legs, often painful and tender; and the effusions previously described may be so dense and abundant as to fix the legs in a semi-flexed position. Node-like swellings are also often observed over the tibia, owing to effusions between the periosteum and the bone. The swelling of the gums is specially noticeable round decayed teeth, and old injuries to the limbs seem to determine the characteristic effusions more particularly than those free from injury. There are also usually a large number of spots and patches, very much like those of purpura, scattered indifferently about the lower limbs. There is sometimes considerable œdema about the ankles; but, in uncomplicated scurvy, pitting on pressure anywhere is the exception rather than the rule. The bowels are more or less constipated, the appetite is good, and there is no thirst. The breath has a peculiar offensive odour, and this may be aggravated by ulceration or sloughing of the gums, or necrosis of the jaw. General debility varies in degree, but may be excessive, with weak voice, and some tendency to fainting, if the patient is put or kept in a sitting position. He feels more or less general aching, and a sensation of contusion in the legs. The skin is dry and harsh, and desquamates over the legs. Heart and lung sounds are normal. The urine is free from albumin, of normal specific gravity, with abundant chlorides. Urea, phosphates, and potassium are said to be deficient.

Complications and Sequelæ.—Simple scurvy is now rarely seen inland, except among the extreme poor who may be unable to purchase vegetables, and who live merely on tea and bread. Nor is it very often seen afloat. It still, however, complicates to a considerable extent diseases or accidents that occur at sea, and so prolongs convalescence almost indefinitely. A sailor, for example, goes out from England to Calcutta, and shortly after arrival in that port is attacked with dysentery or intermittent fever, fractures a limb, or becomes syphilitic. He remains in India a very short time, ships in a convalescent and enfeebled condition, lies up before the ship has been at sea many days, and probably does little or no work during the entire passage. The berth that he occupies constantly (and with very little change of clothing) is probably wet, his food scanty and unvaried, and his lime-juice or other antiscorbutics (as he cannot go to fetch them) served out irregularly, or perhaps refused when given. Under such circumstances, scurvy soon begins to 'colour' the original disease. The intestinal canal in cases of dysentery, the spleen in cases of ague, buboes, and chancres in syphilis, are all attacked, so to speak, scorbutically. Wounds, scratches, ulcers, or any other breaches of surface will not heal, and fractures sometimes become disunited; so that, as a consequence, the recovery of the patient after his arrival is deferred (solely on account of the existence of this scorbutic condition) for several weeks or months. In fact, all processes of repair, internally and externally, appear to be arrested, and no advance is made until the scorbutic symptoms have entirely disappeared. Nyctalopia is sometimes associated with scurvy, and it may be considered that night-blindness is induced by scorbutic conditions, inasmuch as this affection has decreased *pari passu* as scurvy has diminished in the British Mercantile Marine, and is now seldom complained of by sailors. In bad cases, hæmorrhage may take place from mucous surfaces. Nausea and vomiting may also occur.

The sequelæ of uncomplicated scurvy are, practically speaking, *nil*, for the patient, when properly treated, makes a rapid and complete recovery, leaving no trace of the disease behind. There appears, however, to be little doubt that one illness renders the patient less able to resist successfully future attacks of the disease, if placed under the same predisposing conditions. Several instances are recorded of old sailors, who have been the subjects of two or three attacks; but these have been generally complicated with some other disorder, delirium tremens being occasionally superadded.

Diagnosis.—The diagnosis of scurvy cannot be difficult if the symptoms described above exist, and a dietetic history is carefully made out. As Parkes records, in a very valuable paper published on that subject in the second volume of the *British and Foreign Medico-Chirurgical Review*, 'it may be confidently asserted that an invariable antecedent of every case of scurvy is a deficiency or absolute want of fresh vegetable food.' This important item of information being established, the spongy gums, and the bruised-like condition of the lower limbs (this latter condition not being connected with any history of accident or injury), with great general debility, should be sufficient to determine the nature of the disease. For even in mild cases the condition of the gums is quite unlike that produced by mercury. Moreover, the mercurial fœtor is absent, but a fœtid, earthy odour exists. Nor has the dull blue margin seen in the gums in cases of lead-poisoning any resemblance to the scorbutic condition. Scurvy might be occasionally confounded with purpura, as in some cases hæmorrhagic spots only exist about the legs, with no ecchymoses or hardness round the calf and hamstring muscles. But the condition of the mouth, the absence of severe cachexia, and, as Niemeyer remarks, the comparative absence of epistaxis, hæmatemesis, hæmatoma, and bloody evacuations from the bowels in scurvy, will aid at once to settle the diagnosis. The disease is now, under ordinary circumstances, rare among women and children. The possibility of its existence should not, however, be overlooked. Single cases are occasionally noted by physicians, caused for the most part by pursuing strictly a scorbutic regimen, for the purpose of combating some other obstinate disorder.

Prognosis.—Scurvy existing apart from other maladies is not a fatal disease. The patient may be seen in a state of excessive prostration, with feeble pulse, whispering voice, and a tendency to syncope unless the recumbent position be rigorously maintained; but a few days' rest, under favourable conditions, and proper treatment, produce a marvellous change, which results in a steady and very satisfactory convalescence. But before this prognosis is given, care should be taken to ascertain that the scurvy does not cover any other chronic or organic disease. Dysentery, syphilis, and the various forms of intermittent fever are undoubtedly its worst complications, and either of these maladies will, even under favourable circumstances, prolong convalescence considerably. The duration of the disease is limited only by the causes that produce it, for as long as the scorbutic diet and other predisposing conditions exist, so long will the disease retain the mastery, and progressively increase in severity.

Treatment.—If the patient, when first brought under notice, be so ill as to be unable to walk or stand, great care should be taken that the recumbent position is adopted and maintained. Many severe cases of scurvy have been lost by the neglect of this apparently simple precaution. The patient, in the absence of the nurse, sits up in bed, and has a sudden attack of syncope, from which he never recovers. Having regard to this, let the patient be undressed carefully, and washed (without a bath), any wounds or abrasions being covered with simple water-dressing. The direct treatment of the disease is almost purely dietetic, starting upon the principle that want of fresh vegetable diet has been the exciting cause of the illness. So the diet should consist of mashed potatoes; any variety of green meat (the *Cruciferæ* being perhaps the best); oranges, pears, apples; and, as a convenient antiscorbutic, lime- or lemon-juice at the rate of from three to four ounces daily, mixed with about eight times its bulk of water, sweetened to taste, and used as a drink. Solid animal food should be given at least once a day, and in liberal quantity, as soon as it can be properly masticated. We begin in bad cases with beef-tea, mutton-broth, milk, eggs, fish, and minced meat—in fact, any and all varieties of nutritious animal food, in conjunction with the vegetable diet; for the appetite is usually good, and the digestive powers almost unimpaired. If great prostration exist, brandy, in small and frequent doses, must of course be given; but, as a general rule, very little is required. Malt liquors are undoubtedly antiscorbutic, and it is well to give a pint of ale or porter daily if no dysenteric complication exist. Milk is also to a certain extent antiscorbutic, and should be given freely. As regards medicinal treatment, little or nothing need be done. All active treatment, general or local, is almost useless. The administration of mercury to scorbutic patients (through errors of diagnosis) did, in former years, an enormous amount of mischief, and, even in the presence of chest complications, all counter-irritants to the skin must be avoided. Chlorate of potassium, in the form of a mouth-wash, or given internally, probably assists to cleanse and purify the gums and mouth; and if old ulcers or open sores exist upon any part of the body, lint, wetted with weak lime-juice, is said to promote a healthy surface. But whether any complication be internal or external, no processes of elimination or repair will advance satisfactorily until the scorbutic symptoms disappear. If no grave disorder beyond the scurvy exist, recovery is very rapid, and few diseases are so eminently satisfactory to treat. The gum-swellings recede, and the ecchymoses on the legs begin to disappear after two or three days of treatment; and the brawny tenderness of the muscles of the lower limbs diminishes daily, the fibrinous effusions causing it being steadily and quickly absorbed. Dysentery is the most common complication of scurvy, and is usually tedious and troublesome. A fair trial should be given to the treatment above recommended, excluding malt liquors, and substituting a small allowance of brandy, and as a rule the dysentery and scurvy will disappear together.

The antiscorbutic treatment proper to combat the advent of this disease is sufficiently indicated in the above remarks, for it will be plainly seen that scurvy is due to the absence of certain necessary ingredients in diet. When these ingredients cannot be given in the usual form, the most convenient substitutes are lime-juice, lemon-juice, and in a minor degree citric acid. Sir Alfred Garrod recommends salts of potassium. But the great mass of evidence, collected during the last fifty years, goes to prove that lime- and lemon-juice contain, in natural combination, the best and most convenient prophylactic elements against scurvy. Its use in the Royal Navy has, since the close of the last century, been chiefly instrumental in driving the disease out of the Service; and legislative enactments passed in 1867, whereby a proper and genuine supply of juice was secured to all British sailors, have resulted in the decrease of scurvy in our own Mercantile Marine by from 70 to 80 per cent.

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SCYBALA (σκύβαλον, dung).—Fæces in the form of hard rounded lumps, whether discharged or retained in the intestine. *See* STOOLS.

SEA-AIR; SEA-BATHS.—The physiological and therapeutical effects of sea-bathing cannot be separated from those of sea-air; for it is impossible to take sea-baths without being under the influence of sea-air; and the stay at the seaside alone, without sea-bathing, produces on many constitutions all the effects which are usually ascribed to sea-bathing. Residence at the seaside, that is, the influence of sea-air, is to be regarded as a special kind of climatic treatment, while the action of the sea-bath is analogous to the stimulating forms of the cold-water treatment.

As the sea-air and the sea-bath owe part of their properties to the constitution of sea-water, it will be well to begin with the latter, then to consider the characters and influences of the sea-air and the sea-bath, and add some notes on seaside watering-places.

Sea-water. — *Temperature.* — The sea-water is of more equable temperature than the surrounding air. It is, as a rule, warmer than the atmosphere in winter, and cooler than in summer; although on chilly days in summer, especially after a series of hot ones, the temperature of the sea-water is often higher than that of the air. The variations of the temperature of sea-water from night to day, and from one day to another, are much less than those of the air. It would, however, be erroneous to assume, as is sometimes done, that the temperature of the sea-water near the shore is the same at different times of the day. The writer has often measured it at the Riviera, and the south coast of England, and has repeatedly found it on calm and sunny days at one P.M. and two P.M., from 5° to 7° F. higher than on the same days at seven or eight A.M. As to the different seasons, the sea-water reaches its highest temperature in summer much later than the air; and as it loses its heat less rapidly than the latter, it is mostly warmer in autumn and winter than the surrounding air, and gives off warmth to the latter. During the sea-bathing season, namely, from the end of May to the beginning of October, the temperature of the sea-water at the coasts of England, the north of France, Belgium, Holland, and Germany, varies in general from about 56° to 72° F., while in the Bay of Biscay and in the Mediterranean it is considerably higher.

Constituents.—Sea-water holds in solution a large amount of salts, varying somewhat in different localities, and slightly even in the same place at different times. The Mediterranean is richest, with about $2\frac{3}{4}$ to $3\frac{1}{2}$ per cent.; whilst the water at the coasts of the British Channel and German Ocean varies from $2\frac{1}{4}$ to $3\frac{1}{4}$ per cent. The water of the Baltic, owing to the large number of streams which enter it, is much less salt, containing only about $\frac{1}{2}$ per cent. Five-sixths of all the salts are chlorides of sodium and magnesium, whilst the remainder consist of the sulphates and carbonates of calcium, magnesium, and potassium.

Sea-air.—The sea-air, and the air at the sea-shore, are considerably influenced by the constant evaporation taking place from the sea, and also by the temperature of the sea-water. Owing to these circumstances, the sea-air contains in general more moisture, relative as well as absolute; and is more equable in temperature, the summer being less hot, and the winter less cold, at the seaside than at inland places in the same latitude; the day also may be regarded as less warm in summer, the night as less cold in winter. A very important fact is the comparative purity of the sea-air from organic admixture and inorganic dust, while the occasional presence of a greater or smaller amount of saline particles cannot be regarded as a disadvantage. The amount of ozone is greater; that of carbonic acid smaller. The variations of the barometer are greater, but more regular in their occurrence, and this possibly exercises a beneficial influence on the functions of life. The greater density of the atmosphere, which means a comparatively large amount of oxygen in a given volume of air, is often considered as one of the principal causes of the stimulating effect of sea-air; but Frankland's and Tyndall's experiments on combustion render the usual reasoning on this point, with regard to combustion and tissue-change, rather doubtful. Nor is the fact to be overlooked that the air at the sea-shore is mostly in greater agitation than the inland air; and by this circumstance is probably to be explained the experience of Benecke ('Sea-air and Mountain-air,' *Deutsch. Arch. f. klin. Med.*, vol. xiii. p. 80; 1874) that the same body of hot water loses its heat more rapidly at the sea-shore than at various elevations in Switzerland, varying from 3,000 to 6,000 feet above sea-level—an experience from which we may infer that living bodies likewise give off more heat at the sea-shore than in elevated inland regions. The physiological effects of sea-air may be designated, with Braun (*Curative Effects of Baths and Waters*, English edition, 1875, p. 253), as 'powerful stimulation of the change of substance, both retrogressive and formative, expressed in a striking increase of urea, and decrease of uric acid and phosphoric acid in the urine, in the greatly increased requirements of food, and in the rapid and considerable increase of the weight of the body.' A certain power of responding to the increased stimulus of the sea-air is, however, required of the constitution; for the increased tissue-change necessitates an increase in the ingestion of food, and in the processes of excretion of the products of retrogressive tissue-change. If the digestive and assimilative organs be unable to satisfy the former demand, various digestive disturbances arise, the appetite fails, and emaciation is often the consequence. In many of these conditions greater benefit is derived from mountain health-resorts, where the demands made on the constitution are less great, and where less food is required. If the excretory functions be imperfect, as is the case in so-called 'bilious' individuals, and in some undefined gouty tendencies, headaches, giddiness, constipation, or other symptoms usually called 'biliousness,' make their appearance, and sometimes render the removal from the sea-shore necessary, though the use of aperient remedies, reduction in the amount of food and especially of stimulants, and active exercise at some distance from the sea, often suffice to correct this defective elimination and its consequences. In many cases of this kind, however, courses of mineral waters, especially the alkaline, saline, or common salt springs, ought to precede the stay at the seaside. *See* MINERAL WATERS.

Sea-baths.—The sea-bath may be regarded as a powerfully stimulating cold-water bath, modified in its action by the saline ingredients; by the admixture of mechanical particles, organic as well as inorganic; by the varying degree of motion through the waves; and by the alternation in the exposure of a part of the body to the waves and to the air. We have already discussed the temperature of the sea-water, and the saline ingredients; but the temperature of the surrounding air, and the degree of motion in the air, also exercise a modifying influence on the effects of the sea-bath. The motion of the water varies constantly, according to the size and force of the waves, and the effect of the bath to a great degree depends on this point. When the waves are in any degree powerful, the upper part of the body is exposed to the coming, the lower to the receding wave, and the cutaneous nerves are not only influenced by the temperature, but also by the force of the water, and by the sand and other substances mixed with it. In a quiet sea these influences are considerably lessened. The alternation of exposure to the water and the air, likewise occasioned by the waves, is peculiar to the sea-bath, and is another source of constantly changing impressions on the cutaneous nerves.

BATHING SEASON.—The season for sea-bathing varies according to the climate of the locality. Thus it extends on the Mediterranean shores from May to October and even November; on the shores of the English Channel and German Ocean from June to September and the beginning of October. The time of the day for sea-bathing must depend on the individual, on the weather, and on the tide. Delicate persons ought not to bathe with a perfectly empty stomach; but also never after a full meal. The duration of each bath is to be regulated according to the constitution of the bather, the force of the waves, and the temperature of the water. Weakly persons ought not to remain in the water over five minutes, but immersion for one or two minutes is in many such cases all that is useful or permissible; while stronger individuals may remain from five to ten minutes. The bather, we may say in general terms, ought to leave the water as soon as the reaction manifests itself.

In many cases, the warm sea-water bath may be recommended with advantage, when the cold sea-bath is forbidden. Indeed, courses of bathing in warm sea-water are not sufficiently used in a systematic way, though the medical practitioner possesses in them a gentle, manageable, and efficacious means of treatment during winter as well as during summer. They are in their action analogous to warm common salt-baths (*see* BATHS; and MINERAL WATERS). Unfortunately the arrangements at many localities are still very defective. Some physicians at seaside places are beginning to make more extensive use of them, and with excellent results. The tepid swimming-bath of sea-water we may regard as intermediate between the warm bath and the bath in the open sea, and likewise as very useful in appropriate cases. With due care it can be employed also in winter. It offers the advantage of the combination of one of the most perfect modes of muscular exercise, with the exposure of the skin to the influences of the sea-water bath.

The physiological effects of the sea-baths are similar to those of the sea-air. Abstraction of heat and stimulation of the cutaneous nerves lead to increased tissue-change, retrogressive as well as productive. Increased appetite and increased weight of body are usually observed in those who are benefited by sea-baths; while loss of appetite, headache, digestive disturbances, and loss of weight are often observed in those who are unable to bear the shock, or the increased demand on the body, or who remain too long in the bath, or take it too frequently.

Cases not suited for Sea-bathing.—Persons affected with diseases of the heart, or of the blood-vessels and lungs, with angina pectoris, with epilepsy, with organic diseases of the nervous system, with fainting fits, with enlargement of the liver, or with other organic diseases of the abdominal viscera, ought to avoid bathing in the open sea, which may produce most injurious effects, such as violent palpitation and dyspnœa extending over many months, sleeplessness, total loss of appetite, and great emaciation. Old persons, and persons with feeble circulation, whether from age or otherwise, ought to avoid bathing in the open sea, excepting on warm days, and with a very quiet sea.

Cases to be benefited by Sea-bathing and Sea-air. — Sea-bathing is useful in many conditions connected with weakness or atony of the skin, such as tendency to profuse perspiration, or to taking cold at every change of temperature, or exposure to wind or draught.

In scrofulous complaints, long-continued residence at the seaside promises more than other climatic agents; but, as we have to deal with constitutional defects, and as our aim must be to alter the constitution, two, three, or even more years are often required. In many cases, judicious courses of sea-bathing, the use of warm sea-water baths, and sponging with sea-water, assist the climatic element of seaside residence. Education at schools situated at the seaside offers, in scrofulous children, the greatest advantages.

In muscular rheumatism, the moderate use of the sea-bath combined with sea-air is useful. In more recent rheumatic joint-affections the sea-bath is mostly injurious, whilst the more gentle action of the sea-air, combined with the use of warm sea-water in local and general baths, is frequently beneficial. Persons affected with so-called nervous rheumatism—a term which is applied sometimes to hysterical cases, sometimes to spinal irritation, and also to rheumatism combined with nervous weakness—often derive benefit from the gentle use of the sea-bath, and still more from the sea-air.

In some functional diseases of the nervous system, the sea-bath forms an excellent remedy, if it be adapted to the individual case; for instance, in hysterical paralysis and other forms of hysteria, in the milder forms of diphtheritic paralysis, and in nervous dyspepsia. It must, however, be borne in mind that many persons, with a tendency to neuralgia, nervous asthma, hysterical convulsions, and other forms of hysteria, are unable to stand prolonged residence at the sea, especially at the Riviera. In such cases, mountain climates are generally more advantageous during summer and autumn. In many forms of anæmia, when it does not depend on organic disease of the heart and blood-vessels or other viscera, but on direct loss of blood or its constituents, on confinement, grief, and imperfect food, on slow and imperfect development, sea-air exercises a good effect. Hence the benefit obtained in many cases of amenorrhœa, chlorosis, and allied complaints, if the tendency to constipation is sufficiently combated. Often, however, the demands made by the sea-air on the constitution are too great, and the invalids lose weight; whereas they gain on mountains of moderate elevation.

In chronic pneumonia, in the remains of pleuritic effusion, and in phthisis, the sea-air, by its purity and its more equable temperature, is useful; but as wind is in most cases to be avoided, sheltered localities are essential. Sea-bathing is in this class of cases hazardous. The beneficial effects in whooping-cough, when the first stage is over, are well-known. Regarding asthma, nothing can be said with certainty; some cases of nervous asthma are benefited at the seaside, while a large percentage are aggravated; on the whole, the writer's experience is more in favour of elevated regions than of the seaside. Whenever the effect is not yet known, the recommendation of seaside residence or mountain-air must be regarded as a trial; but in young persons affected with asthma, mountain climates are in general preferable. The advantage to be obtained in tendency to catarrh we have already mentioned.

In addition to the conditions named, there are many which cannot be designated by the name of any disease; but which are only states of weakness, manifesting themselves in various ways, as inability to sustain mental or bodily efforts, tendency to abortions, to leucorrhœa without any disease, &c. In such states of weakness the stimulating effect of the sea-air, combined with the grand aspect of the sea, are found eminently useful.

Seaside Watering-places. — England is remarkably well provided with seaside places, and the different localities offer considerable variety with regard to climate. The east coast, which may be designated as drier and more bracing, is especially to be recommended from the middle of June to the middle of October. The principal places on this coast are, beginning with the north, Berwick-on-Tweed, Tynemouth, Redcar, Saltburn-by-the-Sea, Whitby, Scarborough, Filey, Bridlington, Cromer, Yarmouth, Lowestoft, Aldborough, Felixstowe, Dovercourt, Walton-on-the-Naze, Southend, Margate, Broadstairs, Ramsgate, Deal, and Dover. On the south-eastern and southern coast, which may be regarded as intermediate between the eastern and the south-western coast, we have Folkestone, Sandgate, Hastings with St. Leonards-on-

Sea, Eastbourne, Seaford, Brighton, Worthing, Littlehampton, Bognor, the Isle of Wight, Bournemouth, and the Channel Islands. These places differ considerably with respect to the soil on which they lie; the position—close to the sea or on a cliff; the aspect; and the configuration of the locality itself and the surrounding country. Even different parts of the same place offer different advantages. Thus the lower part of Folkestone, near the lower Sandgate road, is sheltered from the north by the cliff, while the houses on the cliff itself are more or less freely exposed to the winds from all quarters, and therefore preferable during the summer months. Hastings with St. Leonards is remarkably sheltered from the north, north-west, and to some degree from the north-east winds, and is through this, and through the influence of the sea, some degrees warmer during the late autumn and the early winter months—we may say till February—than closely adjacent but less sheltered places. In the Isle of Wight, the Undercliff, with Ventnor and Bonchurch, is sheltered by the hills from north and north-east winds, like Hastings, and more so; and has during winter a more equable and a higher temperature than other parts of the island. The Undercliff is therefore more adapted for climatic treatment during the colder part of the year; while Sandown, Shanklin, Cowes, Ryde, Alum Bay, and Freshwater are more suited for sea-bathing and climatic purposes during the warmer months. Bournemouth is sheltered as well by the configuration of the hills as by the pine-woods, which serve as a protection from violent winds. On the south-western coast, which may be regarded as somewhat moister and more sedative, Swanage, Weymouth, Sidmouth, Budleigh Salterton, Dawlish, Torquay, Teignmouth, Falmouth, Penzance, and Newquay are the principal sea-bathing places, amongst which Torquay may be regarded as the most important winter health-resort. On the North Devon coast we may name Clovelly, Lynmouth, Ilfracombe, Westward Ho, and Minehead; on the Bristol Channel, Weston-super-Mare, Portishead, and Clevedon; on the Welsh coast, Tenby, Aberystwith, Penmaenmawr, Llandudno, Rhyl; and in Lancashire, Westmoreland, and Cumberland, Grange, sheltered by configuration, Southport, Blackpool, Fleetwood, St. Bees, and Silloth. Important by its island climates is the Isle of Man.

Scotland likewise offers abundant localities for sea-bathing, the most frequented of which are Nairn on the east coast, Rothesay in Bute, Ardrossan near the Firth of Clyde, and the Isle of Arran in the west.

Ireland is even richer, with Bray and Kingstown, near Dublin; Duncannon, Tramore, and Dunmore on the south coast; Rostrevor and Portrush farther north; Bundoran in the north-west; Kilkee in the south-west; and Queenstown, a sheltered and warm, but moist, climatic health-resort in the south, where are also Youghal and Ballycotton.

On the north coast of France, Calais, Boulogne, St. Valery, Trèport, Dieppe, Etretat, Fécamp, Havre, Trouville, Deauville, Villers-sur-Mer, and Dinard are the most favourite resorts; on the south-west, Arcachon and Biarritz; and on the south, Marseilles, Hyères, St. Raphael, Cannes, Antibes, and Nice.

The west and south-west coasts of Italy possess many good localities for sea-bathing for those requiring, or at all events bearing, heat, such as Bordighera, Alassio, San Remo, Castellamare, Sorrento, and the islands of Capri and Ischia.

On the coast of Belgium, Holland, and Germany the most important localities are Blankenberghe, Ostend, Scheveningen, Heligoland, Borkum, Norderney, Baltrum, Langeroog, Spikeroog, Wangeroog, Dangast, Cuxhaven, Wyk, and Westerland.

The shores of the Baltic possess likewise many delightful localities, such as Heringsdorf, Putbus on the island of Ruegen, Warnemuende, Travemuende, Doberan; but the sea-baths and the climate are less stimulating than on the shores of the German Ocean.

The coasts of Norway, Sweden, and Denmark offer likewise good opportunities for sea-bathing, combined with bracing sea-air, from July to September.

HERMANN WEBER.

SEA-SICKNESS.—SYNON.: Fr. *Mal de Mer*; Ger. *Seekrankheit*.

DEFINITION.—A peculiar functional disturbance of the nervous system, produced by shock, resulting from the motion of a ship. The most prominent symptoms are a state of general depression, giddiness, vomiting, and derangement of the bowels and of the urinary secretion.

PATHOLOGY.—The immediate cause of sea-sickness is referable to the shock, or series of shocks, to the nervous system produced by the motion of a ship. A precisely similar condition may frequently be induced by any forcible motion for which the individual is unprepared, or to which he is unaccustomed, as the motion of a swing. The nervous system is taken unawares, and is unable to adapt the emissions of nerve-force to the unexpected demands made on it. The momentary displacement of the viscera, especially the stomach, the unusual impression on the vision, and the feeling of insecurity, further contribute to the general shock.

The action of the heart and of the arteries is deranged through reflex influence, causing giddiness from anæmia of the brain, and diminished peripheral circulation. The stomach is also affected through reflex action, rendering it intolerant of the presence of any substance, and causing the gastric juice to be actively secreted. The acid secretion acts as a direct irritant to the stomach, and prolongs the sickness. At length *habit* enables the nervous system to adapt itself to the new condition of motion, and to overcome the disturbing influence; shock consequently ceases to be produced; the reflex derangements of the circulation and viscera, giddiness, nausea, and other disorders, are no longer called forth; and convalescence ensues. It is not within the scope of this article to notice the many theories which have been adduced to account for sea-sickness, but most late writers attribute it to reflex nervous disturbance. Some persons are totally insusceptible to the shock producing sea-sickness.

Constipation is probably the result of the want of the gastro-biliary juices and mucus in the bowels, these being vomited; and the diminution of urine may be accounted for, in part at least, by the increased secretion of mucus and saliva.

Anatomical Characters.—The writer has only had the opportunity of taking notes of one necropsy in a case of ordinary sea-sickness, in which the patient died suddenly. The appearances were those of death by simple syncope, there being no organic disease present. The brain, however, was not examined.

Symptoms.—Sea-sickness may be divided into the stages of (1) Depression, (2) Exhaustion, (3) Reaction, and (4) Convalescence.

The early symptoms are sudden giddiness, slight at first, but increasing with the motion of the vessel; and a sense of weight and uneasiness at the epigastrium, speedily followed by nausea and vomiting. At first any food that may have been in the stomach is rejected; and afterwards acid, greenish-yellow, gastro-biliary secretions, often in large quantity, with mucus. Diarrhœa is sometimes present, but constipation is more usually the rule throughout. The flow of saliva is increased, while the urinary secretion is lessened. Appetite is lost, even the sight or smell of food being loathsome. The secretion of milk is frequently arrested in nursing women; in others the menstrual flow is augmented. Sea-sick patients are always worse in the morning. Women suffer more severely than men as a rule, while old people and young children are but slightly affected, or escape altogether. In the majority of cases a favourable *reaction* takes place without further symptoms, the vomiting and nausea cease spontaneously, a ravenous appetite succeeds, and the patient feels well. In other instances great *exhaustion* supervenes rapidly or gradually. The patient feels miserably helpless. He suffers from coldness of the extremities, thirst, headache, and spasmodic pain in the stomach, and complains of numbness of the surface of the body. There is frequently a great tendency to heavy sleepiness; and vomiting of gastro-biliary fluids, sometimes mixed with striæ of blood, takes place whenever they collect in the stomach. A semi-comatose condition, from which the patient is with some difficulty roused, is sometimes met with in very severe cases, and requires assiduous treatment.

In these prolonged cases reaction may assume a febrile character, with a rapid pulse, flushed face, hot skin, and urine containing lithates; and convalescence is slow.

An occasional but rare form of sea-sickness is swooning, but without vomiting or any other symptom. The patient lies motionless and almost deathlike for a variable period. This state is not without danger. Another form is intense frontal headache, neuralgic or anæmic.

Complications and Sequelæ.—Fainting and hysterical attacks are the most common complications of sea-sickness in women. Pregnant women occasionally abort. A weak and irritable condition of the stomach, resembling subacute gastritis, or a state of general debility, may remain for a long time.

Duration.—The ordinary duration of sea-sickness in long voyages is from three to five days, but it may last for weeks.

Prognosis.—This is almost invariably favourable; yet death, although extremely rare, may occur from syncope or from exhaustion.

Treatment.—It may be premised that there is no known means of preventing sea-sickness in susceptible persons. The majority of cases get well spontaneously, but there are many which will require systematic treatment, especially in long voyages. Measures should be taken to counteract the nervous shock, and to sustain the system during its continuance.

Diet before embarking should be light. Fresh air is a powerful element in the treatment, to obtain which the voyager should remain on deck whenever the weather permits, or in a deck-room. The temperature of the body should be maintained by wrapping up in shawls, and hot bottles applied to the feet if necessary. The face may be bathed occasionally with eau-de-Cologne, and the vapour of ammonia inhaled through the nose. In the early stages alkalis are indicated, to counteract the irritant effects of the acid gastro-biliary secretions, together with diffusible stimulants frequently administered. A draught may be given, consisting of bicarbonate of sodium, grs. 10–20, ammoniated tincture of valerian, ♏xv, chloroform, ♏iii–v, dissolved in half a drachm of rectified spirit, mucilage of acacia, ʒjss, and camphor water to ℥j. Such a draught may be given every two hours, or, omitting the mucilage, it may be given in effervescence with citric acid. Chloroform is valuable as a sedative to the stomach, as well as being a general stimulant. Other useful drugs are compound spirit of ether, diluted hydrocyanic acid, and, in prolonged cases, bismuth salts. Iced champagne is often valuable. Ice slowly sucked allays thirst, and relieves vomiting. A full dose of opium sometimes acts like a charm, through the rest which it procures, or morphine may be injected subcutaneously. Hydrate of chloral is also a valuable remedy of this class. Nitrite of amyl and nitro-glycerine have been successfully employed in some instances. Phenazone, acetanilide, and other agents of this class are now much employed in the treatment of sea-sickness. Hydrochlorate of cocaine is also a favourite remedy.

External sedative applications over the stomach do good, such as a liniment composed of equal parts of belladonna, chloroform, and camphor liniments; and a binder rolled firmly round the body is useful. When the patient is in his berth he should lie on his back, with his head low, as immovable as possible. Notwithstanding the vomiting, food should be pressed on the patient; and, lest exhaustion occur, light semi-fluid food is the best, such as arrowroot, given frequently in small quantities. Afterwards toasted bread, with beef-tea or chicken-broth, and, when these are borne, boiled fowl, pickled meats, or corned meat with pickles, may be tried. Acids at this stage aid digestion, which has become weakened through the vomiting of so much gastric juice and bile. Beer and alcoholic drinks should be avoided in the earlier stages; but at a later period, claret, champagne, brandy, or stout may be allowed with benefit. Diarrhœa and other symptoms should be treated on general principles. For short voyages, the best that can be done is to remain on deck when possible, avoid alcoholic drinks, and follow the general directions above given. The application of ice along the spine is occasionally successful in arresting the vomiting. ISAIAH DE ZOUCHE.

SEA-VOYAGES. — Sea-voyages have from remote antiquity formed a mode of treatment in chronic diseases, especially of the respiratory organs, and have more lately been much recommended in the treatment of consumption and scrofulous affections; but the different influences to which the invalid is exposed on long sea-voyages are but little appreciated in their details by the majority of the public, or by medical men.

The essential advantages which are generally ascribed to sea-voyages are the enjoyment of perfectly pure sea-air, abundance of light, and free exposure to the sea-breezes; absence, or at all events great limitation, of bodily exertion; and the probability of psychical repose. The uninitiated frequently regard these advantages as more or less fixed and, so to say, measurable qualities, and speak of sea-voyages in the same way as of sea-bathing, cold-water treatment, mineral-water cures, or mountain climates. The advantages of sea-voyages are, however, by no means fixed qualities, and they are often mixed up with unfavourable influences, such as bad weather, sea-sickness, improper food, &c. In everyday life it is an acknowledged fact, and not less so in all climatic cures, that the house in which the invalid lives exercises a most powerful influence on his chance of regaining and maintaining his health; and that the house alone often mars the effect of the best-adapted climatic change. In the same way the floating house, the ship, with its arrangements, forms one of the most important elements in the compound agent ‘sea-voyage.’ The arrangements of ships, however, are notoriously often very imperfect, and the narrow cabin never stands comparison with a good bedroom, the only counterbalance to this drawback often being that the invalid is forced to be the whole day long on deck, that is, in the open air, in order to escape from the confined state of the cabin. By this circumstance alone, however, the majority of the more serious cases ought to be excluded from sea-voyages in ordinary ships, as they cannot be easily moved from the cabins to the deck, and *vice versâ*. The hygienic conditions of the ship, the space allotted to each passenger, the ventilation of the rooms, the arrangement of the decks, must in every case be a matter of careful inquiry; but it would require too much space to enter into the details in this place. There are iron and wooden ships, steamers and sailing vessels. The iron ships have the advantage of being easily kept clean and free from smells, but they are apt to become very hot under the influence of the tropical sun. The sailing vessels can be kept more free from smoke and dust; but they are dependent on wind, and if they meet in the tropics with perfect calms (doldrums), the passengers may have to endure intolerable heat for several days and possibly weeks. The combination, therefore, of sailing power for ordinary conditions, with steam to be used only in case of need, would appear to possess the preference for ships to be used for therapeutic purposes (invalid ships).

A second point of paramount importance for every delicate person is the food, and in this respect again the ship-life on long voyages is less advantageous than the life in well-supplied health-resorts or at home. Although the food on first-rate ships is now much improved, compared with former times, yet it is impossible to offer the same variety, or the same delicate cooking, as in first-class hotels or private establishments. A certain amount of monotony in food is scarcely to be avoided, and invalids with a delicate appetite ought therefore not to attempt long sea-voyages, excepting under very favourable circumstances, as, for instance, on large private yachts provided with good cooks.

Sea-sickness, or rather the degree of liability to sea-sickness, depends on peculiarities of constitution, which are only to be recognised by exposure to the influences of the open sea in different states of agitation. *See* SEA-SICKNESS.

We have given, in the article on SEA-AIR, the prominent qualities of sea-climates; but the most cursory consideration of the climatic conditions to be encountered in a long sea-voyage shows that there must be great differences between the physiological and therapeutical influences of sea-climates in latitude 50° and in latitudes 15° and 5°. The air in the tropical regions has a much higher temperature, and a larger amount of absolute moisture; the atmospheric movement is, as a rule, though by no means always, slighter; the barometric pressure is somewhat less in the tropics than in the temperate zones; and the daily and annual variations of atmospheric pressure are greater in the former than in the latter. There is also a difference between the same degrees of latitude on the north and south of the equator, the temperature in the southern hemisphere, for instance, being somewhat lower than in the northern; but these differences are comparatively small. The effects on the constitution of the climatic conditions of sea-life in different latitudes are very complicated. We will here only point to a few facts, namely, that in some delicate constitutions the functions of life are performed more easily under the influence of greater heat; that many delicate persons can eat and digest better, are able to take more exercise, sleep better, and that their mental functions are more active under the same circumstances; but that in the majority of average persons continued great heat produces lassitude, a tendency to diarrhœa and other digestive derangements, and imperfect sleep. Further, that in most individuals the bodily temperature rises above the natural heat (in general about $\frac{1}{2}$° F., and in some persons as much as 2° and 3° F.); and that pulmonary hæmorrhage occurs more frequently under high than under ordinary degrees of heat. Morbid states accompanied with pyrexia and with a tendency to pulmonary hæmorrhage ought therefore not to be exposed to tropical heat.

The climatic conditions to be met with in different voyages through the same regions vary at different seasons, but they vary still more in voyages through different seas, especially according to the longitude and latitude. Our knowledge of different sea-climates, that is, of the different climatic conditions in different parts of the ocean, is as yet not perfect. Dr. Faber (in a communication 'On the Influence of Sea-voyages on the Human Body,' *Practitioner*, March 1876) shows that the equability of sea-climates is by no means so complete as is generally assumed; and that great changes in temperature and atmospheric movements occur not rarely on successive days, and even on the same day.

THERAPEUTICAL USES.—The opinions of different writers on the therapeutic value of sea-voyages in the treatment of disease vary considerably. In the last century Gilchrist revived the practice of sea-voyages, and strongly recommended them in cases of phthisis. In more recent times Jules Rochard, the well-known French climatologist, has collected a large body of evidence from the French Navy to dispel the faith in sea-voyages; but we must bear in mind that the hygienic conditions in which the sailors used to live were not perfect, and are no doubt inferior to those of well-arranged private ships of the present day. Dr. Walshe, on the other hand, was in favour of well-planned voyages; and Dr. C. T. Williams and the writer have likewise obtained fair results in well-selected cases. The majority of physicians entirely, or almost entirely, confine themselves to diseases of the respiratory organs in recommending sea-voyages; but their therapeutic field is no doubt much larger, and the result is probably more generally favourable, in some other complaints.

1. *Phthisis.*—The writer has had the opportunity of witnessing the effects of sea-voyages, of two to seven months' duration, in sixty-two cases of phthisis in the first or the beginning of the second stage. Of these sixty-two cases thirty-eight benefited considerably, twelve remained stationary, twelve became worse. The voyages were all either to the Cape of Good Hope and back, or to Australia and New Zealand and back, between the months of September and May. Of the twelve bad results, seven occurred in patients who went to Australia and India and back, with scarcely any rest on land; they seemed to have gained in the first part of the journey, but more than lost the gain in the latter part, apparently from dislike of food, from the monotony of the life, and from exhaustion. Out of twenty-six cases in the first stage twenty were more or less improved, three remained stationary, three lost ground. In eighteen cases of phthisis in the second stage, the result of sea-voyages was favourable only in eight, indifferent in five, bad in five cases. In seven cases in the third stage, the result was bad in three, indifferent in three, favourable in one. The writer has also notes of eleven cases of phthisis in the first and the beginning of the second stage, where long summer voyages (namely, from three to five months) with whalers to the northern seas were tried, the result being favourable in nine cases, indifferent in one, and unfavour-

able in one, apparently through inability to bear the want of variety in food.

2. *Laryngeal and bronchial catarrh and asthma.*—In simple chronic catarrh of the larynx, sea-voyages, or cruising in yachts from this country to the Mediterranean, to the Azores and Madeira, had very good results in twenty cases out of twenty-four. Satisfactory was also the effect of a similar plan in eleven cases of chronic bronchial catarrh. In a tendency to bronchitis from pulmonary emphysema the benefit was likewise evident in ten cases out of twelve; but here the effect was, from the nature of the circumstances, less permanent. Of eight cases of asthma, two cases of a bronchitic kind were benefited; two of a nervous character aggravated; and four were neither better nor worse. Eight cases of hay-asthma were, while on the high seas, quite free, but those who returned while the complaint was still in season, were immediately attacked.

3. *Scrofula.*—In fifteen cases of scrofulous affections (caries of bones, affections of joints, glandular swellings and ulcerations) one or several long sea-voyages were tried; in eleven of them the effect was quite satisfactory, in four less decided.

4. *Vesical disease.*—In three cases of irritable bladder sea-voyages on yachts in warm climates have likewise proved useful.

5. *Cardiac disease.*—Decidedly injurious was the effect of sea-voyages in five cases of dilatation of the heart, combined with chronic bronchitis. In two cases of enlargement of the liver, connected with weakness of the heart, the result was likewise unsatisfactory.

6. *Skin-disease.*—Chronic eczema was, in five cases out of six, aggravated by sea-voyages.

7. *Nervous disorders.*—In four out of six cases of mental irritability, long sea-voyages, especially in yachts, had favourable results; in the fifth the mental condition was aggravated; in the sixth great improvement of the mental state was obtained, but this was accompanied by considerable exhaustion, from inability to take a sufficient amount of food. Of four cases of melancholia, two were apparently cured, the third remained uninfluenced, and one committed suicide by jumping overboard. In four cases of tabes dorsalis, in the earlier stage, cruising in comfortable yachts in the Mediterranean, with occasional landing, during the autumn, winter, and spring months, has been very beneficial; in two of these the disease has apparently been arrested, by persevering with this course during fifteen and sixteen years.

8. *Dipsomania.*—Finally, the writer has tried long sea-voyages in yachts in five cases of dipsomania, stimulants having been entirely excluded from the dietary. In one of these cases the result appears to be permanently good; in the four others it was good for the time with regard to the state of the body as well as of the mind, but there were relapses, which in two of the cases have led to several repetitions of the trial, each time apparently with more lasting, but as yet no permanent, result. Well-arranged sea-voyages deserve, therefore, at all events, a place in the management of this most terrible affection.

CONCLUSIONS.—From a comparison of these experiences with those of other observers, the writer is inclined to infer that, under favourable circumstances, sea-voyages of not too long duration may be rendered beneficial in the early stages of phthisis. The voyage to Australia and New Zealand and back, after a stay of a few months in these climates (Hobart's Town, in Tasmania, for instance), specially recommends itself. The invalids referred to left in the second half of September, or in October or November, and returned in May or June. In this way the more unfavourable seasons of England are avoided, and instead of the short and sunless days, long and bright ones are obtained. To go to Australia and to return immediately has proved exhausting in several instances. Another good plan is to go to the Cape of Good Hope, and ascend in easy stages, by diligence and bullock-carts, to the higher regions (Bloemfontein, for instance), and to return after a stay of three or four months or more. This plan, however, is rather expensive; and it requires a considerable amount of bodily strength, and the inclination to stand a certain amount of roughing with regard to accommodation and food.

The voyage to the northern seas requires a peculiar mental disposition, and would, under the present conditions, be resorted to only under exceptional circumstances; but it has been very beneficial in the nine cases of early phthisis mentioned—all of them possessing a satisfactory fund of strength, combined with love of sea-life and a good digestion.

The combination of yachting in the Mediterranean, and residence at one or several of the health-resorts of those regions, or with a visit to Upper Egypt, has repeatedly proved successful in cases under the observation of the writer, not only in pulmonary invalids, but also in cases of mental irritability, exhaustion, chronic rheumatism, chronic glycosuria, and gout. This plan, however, is somewhat expensive.

In hay-asthma, sea-voyages during the season of the complaint are to be recommended; but in other forms of asthma the result is uncertain, and the advice should not be given without consideration of all the circumstances. In most cases of younger persons alpine climates deserve to be preferred to sea-voyages.

In some forms of mental irritability, overwork, anxiety about business, and in the earlier stages of locomotor ataxy, sea-voyages, and especially yachting, in the subtropical regions, offer many advantages, particularly during the colder and damper seasons of our climate, as it allows of the combination of the enjoyment of sun, light, and pure air with rest of body and mental repose. In slighter forms of mental irritability or overwork, shorter voyages are often sufficient, and even preferable; and the voyages to Madeira, to the West Indies, or to Brazil and the River Plate, may thus be recommended during the colder season.

Dipsomania and other morbid passions may be treated with great advantage by sea-voyages and yachting, provided that stimulants and the other injurious influences which the weak person is unable to resist can thus be entirely removed.

The time is coming when we shall have *therapeutic ships*, specially arranged for different classes of invalids. It would, for instance, not be wise to mix those suffering from dipsomania with sick persons to whom a moderate amount of stimulants is useful.

CIRCUMSTANCES COUNTER-INDICATING SEA-VOYAGES.—The circumstances which render it necessary to avoid sea-voyages are:—

1. Unconquerable sea-sickness.
2. Great temporary or permanent weakness and exhaustion.
3. Permanent delicacy of appetite, with inability to become accustomed to a certain monotony of food, or to a certain coarseness in the preparation of food.
4. Inability to bear the glare of the sea, as it occurs in tendency to glaucoma.
5. Persistent sleeplessness while at sea.
6. Dilatation and weakness of the fibres of the heart, with or without valvular disease.
7. Enlargement of the liver, especially when caused by dilatation of the right ventricle.
8. Advanced stages of consumption, unless the affection be quite stationary.
9. Morbid conditions with a tendency to pyrexia.
10. A tendency to hæmorrhage.

It is the influence of great heat that ought to be avoided by the two classes of cases last mentioned. A voyage through tropical seas, especially in sailing ships, might prove dangerous in such subjects, from the possibility of being becalmed.

11. A tendency to epilepsy or maniacal fits. This ought specially to contra-indicate sea-voyages to tropical climates.

For further information regarding sea-voyages, reference may be made to *The Ocean as a Health-resort*, 1880, by Mr. William S. Wilson.

HERMANN WEBER.

SEAT-WORM.—A synonym for thread-worm. *See* ENTOZOA.

SEBACEOUS FOLLICLES, Diseases of. — SYNON.: Fr. *Maladies des Follicules Sébacés*; Ger. *Krankheiten der Talgdrüsen.*

The sebaceous follicles of the skin are subject to disease depending both upon internal and external causes. Those follicles which are attached to hairs, and those which are isolated, show little difference in this respect.

Enlargement or *hypertrophy* of the follicles is often seen, and appears to arise chiefly from internal causes, occurring either at a particular stage of development, or from some general alteration of nutrition, such as follows a particular diet or excess of particular kinds of food. This form constitutes *acne punctata*, a disease in which the affected portion of skin appears covered with black spots; these being the openings of the enlarged sebaceous follicles, choked with plugs of sebaceous matter, the outer ends of which become blackened. The plugs or *comedones*, when examined, are found to consist of solid fatty matter (sebaceous secretion), closely packed epithelial scales, and imperfectly formed hairs. The parasite *Demodex folliculorum* is often present, but does not appear to exercise any influence on the disease. Acne punctata occurs in those parts of the body where there are numerous rudiments of hairs, and where hairs grow commonly, though not uniformly, in the male sex. Hence it is confined to the face, neck, and upper part of the back and chest, and usually begins at that period of life, puberty, when these rudimentary hairs normally undergo development.

When *inflammation* is set up in hypertrophied follicles suppuration follows, and we have *acne suppurativa*.

The condition called *lichen pilaris* is substantially the same as hypertrophic acne, being produced by overgrowth of cells in the sheath of the hair and the sebaceous follicle. *See* ACNE.

J. F. PAYNE.

SEBORRHŒA (*sebum*, fat; and *ῥέω*, I flow).—An ungrammatical synonym for stearrhœa. *See* STEARRHŒA.

SECONDARY (*secundus*, the second).—In contradistinction to *primary*, the word 'secondary' is used with the following significations. Ætiologically it implies that a disease is not local in its causation and origin, but is manifested as a *secondary* lesion—either as the result of some general or constitutional condition, or of an affection which has previously involved some other structure or organ, it may be in a remote part of the body. It also signifies the later manifestations of a disease, as distinguished from those which occur at an early period, as in the case of *secondary syphilis* or *secondary cancer.*

The term is, moreover, applied to symptoms, when they are more or less remote from the seat of mischief, or are only indirectly set up by the disease with which they are associated.

Frederick T. Roberts.

SECRETIONS AND EXCRETIONS, Disorders of.—Although the derangements affecting the chief secretions and excretions of the human body are considered separately in other parts of this work, it may serve a useful purpose to deal with them from a general standpoint, as there are several facts which apply to the entire group. Those which have principally to be borne in mind are the secretions poured into the alimentary canal—namely, the saliva, gastric juice, bile, pancreatic juice, and intestinal secretion; the milk; the urine; and the sweat. Of secondary importance, from a clinical point of view, are the various mucous secretions, the tears, and the semen; the serous secretions have also to be remembered. It is assumed that the physiological distinction between a secretion and an excretion is understood.

Varieties of Disorder.—1. Secretions and excretions are very liable to *changes in quantity*. A definite amount of each of these should be formed during the twenty-four hours, varying within recognised limits, and influenced by certain physiological conditions. The quantity produced, however, often deviates from the healthy standard, in the direction either of (*a*) *excess*, or (*b*) *deficiency*. In the former case, the amount of the secretion is often far above the normal, or beyond what is needful for its intended purposes; in the latter case various degrees of deficiency occur, culminating in an absolute suppression of a particular secretion or excretion.

2. *Changes in quality* are also frequently noticed, and these may be associated with changes in quantity, or they may exist alone. The qualitative changes include the absence or deficiency of one or more of the normal chemical ingredients of the fluid; excess of either of these ingredients; absence, deficiency, or imperfection of formed organic elements, as in the case of the semen; or the presence of adventitious and abnormal ingredients. It may also be mentioned here that the quality of secretions is often modified by admixture with excess of mucus, or with morbid products.

3. Another disorder affecting certain secretions and excretions is *interference with their escape* by the normal channels, so that they are retained. This applies particularly to those which have one or more special ducts for their exit, liable to be obstructed in various ways. The escape of the bile, pancreatic juice, urine, parotid secretion, milk, and other fluids may be thus prevented.

4. Allied to the deviation just noticed is that in which a secretion *flows in some abnormal direction*. As illustrations may be mentioned salivary fistula, in which the parotid secretion escapes through an opening on the outside of the cheek; external biliary fistula, or the opening of the gall-bladder in various other directions; vesico-vaginal or vesico-rectal fistula, where the urine passes from the bladder into the vagina and rectum respectively; and closure of the lacrymal duct, so that the tears flow over the cheeks. In this connexion allusion may also be made to those cases in which a reservoir of some secretion ruptures, and thus its contents escape. For instance, the gall-bladder may give way, or the urinary bladder, the bile or urine consequently escaping into the peritoneum.

Ætiology.—The causes which produce one or other of the disorders of secretion just indicated are as follows: (1) Alterations in quantity and quality are often immediately induced by nervous disturbance. The influence of the nervous system upon the function of secretion is well known, and it may be centric in origin, as in the case of strong emotion: direct, when the nerve influencing a particular secretion is irritated, compressed, or otherwise disturbed; or reflex, due to some remote irritation affecting such a nerve. The effect of neuralgia upon the secretion of the tears, saliva, and perspiration is often very striking. (2) Similar disorders frequently depend upon derangements affecting the local circulation in the secreting gland. This is well exemplified in the case of the urine, which is abundant and watery as the result of active congestion of the kidneys; deficient, concentrated, and otherwise abnormal when these organs are the seat of venous congestion. The bile is also considerably modified in quantity and quality by congestion of the liver. (3) General conditions of the system materially affect secretions, from various causes, such as pyrexia, plethora or anæmia, shock or collapse, and the typhoid condition. Moreover, they may be disordered in connexion with diseases which produce marked effects upon the general system, such as phthisis. (4) Functional derangement of the glandular structures which form different secretions are very common, and may be due to many causes. Amongst others may be mentioned a want of adequate and proper stimulation; excessive or too frequent stimulation; injurious habits which affect certain secretions; and want of tone or imperfect nutrition of secreting tissues. Such causes frequently operate injuriously in relation to the secretions poured into the alimentary canal. The sweat is affected by neglecting cleanliness of the skin. (5) Organic diseases of the glandular structures necessarily modify secretions more or less, either temporarily from acute disease, or permanently from some chronic mischief, which may ultimately entirely check a secretion. These diseases are of different kinds, and cannot be specially indicated here, but they all tend to alter or destroy the secreting structures. (6) The secretions generally may be affected by certain abnormal elements which accumulate in the blood. Under such circumstances, however, some excretions become the special channels for the elimination of these elements, and thus are liable to be seriously deranged. Thus in diabetes mellitus, whatever its pathology may be, the accumulation of sugar in the system leads to the characteristic changes in the urine observed in this disease, while at the same time the cutaneous excretion is diminished. It may further be remarked here that, if the elements which ought to be removed by a certain excretion are not thus eliminated, they may find their way by other channels, and thus modify the quality of other fluids. This is exemplified by the elimination of urea in other directions when it is not excreted by the kidneys. (7) A secretion may be properly formed, but it is in many cases subsequently modified by admixture with morbid products derived from surfaces with which it has to come in contact, such as excess of or unhealthy mucus, or pus. Also, in the case of the alimentary canal, the habit of taking large quantities of water or other fluids may so dilute the digestive secretions as to make them unfit to perform their functions properly. (8) With regard to the causes which impede the escape of secretions, these are either of a mechanical nature, the duct being obstructed by something lodging in it, such as a calculus or plug of mucus, or being pressed upon from the outside; or due to organic disease, narrowing or closing the channel or its orifice; or possibly occasionally to muscular spasm or to paralysis of the duct. Such conditions may be temporary or permanent. The discharge of secretions in abnormal directions is the result of organic lesions, either congenital or acquired, as the result of which the unusual channels and communications are formed.

Effects and Symptoms. — Disorders affecting secretions and excretions are often directly accountable for a variety of symptoms, as well as for certain definite morbid conditions, and these effects are usually readily explained.

1. With reference to their *quantity*, secretions and excretions must be regarded as mere liquids of a particular kind, and symptoms may therefore simply depend upon their amount. For instance, deficiency or excess of saliva and buccal mucus will cause respectively dryness of the mouth, or a more or less profuse overflow; an undue abundance of gastric juice may account for acidity and acid eructations; the quantity of the secretions in the alimentary canal often aids in the causation of diarrhœa or constipation; and variations in the amount of the cutaneous excretion are evidenced either by free sweating or by dryness of the skin.

2. Certain *actions* are frequently influenced by disorders of secretion. Mere alterations in quantity may affect these actions. Thus, profuse salivation causes frequent spitting or swallowing; abundant secretion in the air-passages excites coughing and expectoration; excess of fluid in the stomach and intestine may cause vomiting or purging respectively; a free secretion of urine renders micturition more frequent. But, apart from the quantity, the quality of a secretion may further influence these actions. Of this we have a striking illustration in diabetic urine, which is in itself irritating, and often excites the bladder to empty itself. The bile is another example, for undoubtedly, in the writer's opinion, this fluid has an irritating effect upon the intestine, and may also increase the secretions of this canal, so that in these ways excess of bile may be a cause of diarrhœa, while its deficiency is an important factor in many cases of constipation, owing to the want of its stimulating action upon the intestinal wall.

3. Each secretion, as distinguished from an excretion, has certain definite *functions* to fulfil, and a number of symptoms may be due to the fact that a particular secretion fails to perform these functions. This may arise from the fact that it is suppressed or deficient in quantity; abnormal in quality, and therefore inadequate for its work; or for some reason or other does not reach the place in which this work is carried on, as when a duct is obstructed, or a fistula allows the escape of a secretion, so that it is lost. Symptoms arising from this cause are mainly observed in connexion with the alimentary canal, and they are of extremely common occurrence, as well as of diverse character. Many of the symptoms in dyspeptic cases are to be thus explained, and a knowledge of the physiological uses of the different digestive secretions will indicate the derangements to be anticipated when one or other of them is unequal to its work. It must be remembered not only that these secretions are concerned directly in digesting the different elements of food, but that some of them also prevent fermentation and decomposition, and their imperfect action in these respects may originate important symptoms. Under this heading the lacteal secretion may be alluded to. Deficiency in its quantity, or imperfection in its quality, often renders it unfit for its intended purpose, that is, the proper nourishment of the infant who is supposed to live upon the maternal milk.

4. If certain secretions or excretions are

seriously checked or altogether suppressed, or if they are retained in the body, so that they become subsequently absorbed, obvious effects on the *general system* are produced, which may be of a very serious character. Thus, in the case of the bile, jaundice and its accompanying phenomena are evident; in connexion with the urine we may have dropsy or uræmic symptoms. Impaired cutaneous excretion also produces effects upon the system, although these are not so characteristic.

5. What may be regarded as the *secondary effects* of disorders connected with secretions must also not be forgotten. If their escape be prevented, they are liable mechanically to produce more or less important lesions. Thus they often lead to distension of hollow organs, such as the bladder or gall-bladder. Moreover, they may at the same time excite irritation and inflammation, especially if, as in the case of the urine, decomposition, with the formation of irritating products, is likely to take place. By these combined effects, important organs may ultimately be completely disorganised, such as the kidney or liver. Retention of milk in the mammary glands is one important cause of inflammation and abscess in these organs. When certain secretions or excretions find their way into abnormal situations, they may also originate serious conditions. Thus, if urine or bile escape into the peritoneum, acute peritonitis will be set up.

Treatment.—Without entering into any details, it will suffice to indicate in this article the principles upon which disorders of the secretions and excretions are to be treated. (1) Any obvious cause of such disorders must be rectified or got rid of at the outset, if practicable, as, for instance, injurious habits, neuralgia, and many other causes. (2) When secretions are abnormal in their formation, either as regards quantity or quality, means are often within reach for correcting these errors. This result may not uncommonly be effected by acting upon the general system, by means of tonics or other suitable agents, and thus indirectly influencing secretion; but there are also special therapeutic agents employed for their immediate effects upon particular secretions or excretions, such as the gastric juice, the bile, the urine, and the sweat. With regard to quantity, remedies are used to diminish this when excessive, as well as to increase it when deficient. It may be mentioned here that measures for augmenting certain secretions, and especially excretions, are often resorted to for other therapeutic purposes, when they are not in any way abnormal, as in the case of the sweat and urine. Care must be taken not to carry stimulation of secretions too far, otherwise in the long run it is liable to do far more harm than good. This applies particularly to those cases where there is organic mischief affecting the glandular structures, and interfering with their formation. Secretions and excretions are often materially influenced in quantity and quality by acting upon the circulation in the organs which form them, either directly or indirectly. (3) It may be practicable to treat some disease which originates a disordered secretion, and thus to influence it. This may be illustrated by diabetes mellitus, and by diseases of some particular organ whose secretion is affected. In this way marked beneficial effects are sometimes produced. (4) When certain secretions are wanting or deficient, especially the gastric juice and bile, their place may be supplied by administering the essential and active elements of these secretions, or by making them artificially. The pancreas itself, as well as the active principle of the pancreatic secretion, are also now frequently given in different forms. Thus the want or deficiency of these fluids in the digestive process may often be entirely made up for. An important use of some of these substitutes for secretions is that introduced by Sir William Roberts, by which the food is artificially digested in different degrees before it is taken by the patient. (5) The symptoms which disorders of secretions give rise to often need special treatment, whether they be of a local or general character—for instance, constipation, diarrhœa, flatulence, jaundice, uræmia, and other phenomena. (6) In many cases attention has to be directed to the prevention of an accumulation of a secretion or excretion, or to its removal if it should have collected. This may be illustrated by retention of the milk in the mammary gland; and of the urine in the bladder. The effects of any such accumulation also need to be recognised in treatment, such as dilatation of an organ, inflammation, or rupture. (7) Operative procedures may be required in some cases, either to remove an accumulation which cannot otherwise be got rid of, or to cause a secretion to pass along its proper channel, in those cases where there is an abnormal communication or fistula, or a closed passage, such as an obstructed lacrymal duct.

It must be remembered that there are many disorders of secretions and excretions which are merely temporary, and which need no treatment whatever.

Disorders of the so-called 'internal' secretions—for example, of the secretion of the thyroid gland—appear to be associated with deterioration of the general nutrition. *See* Senility.

Frederick T. Roberts.

SEDATIVES (*sedo*, I ease or assuage).—Synon.: Fr. *Sédatifs*; Ger. *Beruhigende Mittel.*

Definition.—Therapeutic measures which exert a soothing action upon the system, by diminishing pain, lessening functional activity, or tranquillising disordered muscular movement.

Sedatives may be divided into the following groups:—

1. **General Sedatives.**—Constitutional sedatives, like stimulants, widely overlap other therapeutic divisions. The type of all soothing action assuredly must be a full narcotic, an anæsthetic vapour, or a subcutaneous injection of morphine, either of which renders the sufferer temporarily oblivious to any excruciating agony, such as that of biliary or renal colic. In fact, general sedatives must be looked for exclusively in the narcotic and anæsthetic class; and if the constant consumption of vital energy by disease be not compensated by sleep, we prescribe opium, chloral hydrate, hyoscyamus, and similar remedies.

2. **Local Sedatives.**—Under this heading we must place extreme cold, which, applied either in the form of ice, or more effectually by the ether spray, deadens the sensibility of the skin, and prevents the prick or cut of an operation from being felt. Next come aconite, opium, cocaine, belladonna, veratrine, and blisters, which soothe by a direct action on the sensory nerves, or by influencing the circulation of the parts around. These are useful in neuralgic or rheumatic pain, or in the acute suffering of superficial inflammatory conditions. Again, some substances may be regarded as sedatives, in virtue of their power in allaying the excessive itching of prurigo and other chronic skin-affections. Diluted hydrocyanic acid, carbolic acid, chloroform, borax, and chloral hydrate are among the best remedies for this purpose.

3. **Pulmonary Sedatives.**—Pulmonary sedatives are also deserving of mention; and, passing by emetics and nauseants, which undoubtedly depress the breathing power, we find that veratrine, Calabar bean, diluted hydrocyanic acid, and several other drugs, directly tend to paralyse the respiratory centre, on which action the greater part of their poisonous influence seems to depend.

4. **Spinal Sedatives.**—Spinal sedatives have precisely an opposite effect to spinal stimulants; and it has been amply proved that Calabar bean, bromide of potassium, and methyl-conine powerfully lower reflex excitability through the cord and the great ganglia of the brain.

5. **Gastric Sedatives.**—Irritable conditions of the mucous membrane of the stomach, giving rise to pain, vomiting, pyrosis, and other symptoms, are commonly met with, and require a considerable variety of treatment. If gastrodynia fails to yield to bismuth, soda, or diluted hydrocyanic acid, recourse may be had to small doses of nitrate of silver or of arsenic; or blistering over the epigastrium may produce the desired effect. If vomiting be the prevailing symptom, diluted hydrocyanic acid again proves useful, carbonic acid in the form of effervescing draughts, or minute and oft-repeated doses of nux vomica or ipecacuanha. Combined with this, we must take especial care to enjoin a mild and unstimulating dietary, of which milk and lime-water should form the principal ingredients.

6. **Cardiac and Vascular Sedatives.** This group have the power of lowering the heart's action. Emetics and tobacco do this by the general depression following nausea and the act of vomiting. Other drugs, however, act directly on the heart itself, either by paralysing the muscular tissue of which its walls are composed, or by a more special influence over its nerve-supply. Slowing of its action may be effected either by stimulation of the inhibitory branches of the vagus, or by interference with the sympathetic ganglia which work in the opposite direction; and experiment has not in all cases made it quite clear which is the true explanation. But whatever the exact physiological explanation may be, we have some practical rules for our guidance in the use of these remedies, especially of digitalis and strophanthus, which, cardiac tonics though they be, are also true sedatives to that organ. When the heart-muscle is weak and languid, its contractions are less efficient than in health; and in order to perform its allotted amount of routine work in propelling the blood, its cavities must fill and empty more rapidly than usual. The result of this is seen in the hurried, feeble, and often irregular pulsations of the organ; and digitalis, by bracing up the muscular fibres, and giving increased tone renders its action more efficient, and enables it to take more prolonged periods of repose. Other cardiac sedatives are aconite, veratrum viride, colchicum, and diluted hydrocyanic acid, but they are seldom used for this purpose, although aconite, whether through its action on the heart or on the small vessels, is very effective in early inflammatory conditions.

R. Farquharson.

SELTERS, in Germany.—Muriated alkaline table-water. *See* Mineral Waters.

SEMILUNAR VALVES, Diseases of.—*See* Heart, Valves and Orifices of, Diseases of.

SEMIOLOGY (σημεῖον, a symptom; and λόγος, a discourse).—A synonym for symptomatology, or the doctrine of the signs and symptoms of disease. *See* Disease, Symptoms and Signs of.

SENILE INSANITY.—*See* Dementia.

SENILITY (*senex*, an old man).—Synon.: Senile Marasmus; Fr. *Vieillesse*; Ger. *Greisenalter*.

Definition.—That condition of body which usually supervenes naturally after the seventieth year, but sometimes occurs prematurely.

Senility is separated from the previous period of maturity by the climacteric stage, which in men occurs between the ages of fifty and sixty, and in women about ten years earlier. When of premature occurrence this state is commonly hereditary, or secondary to some exhausting illness, where failure of the trophic influence of the nervous system has been marked. All the signs and symptoms of senility have been seen in individuals under twenty years old.

We do not know why the body, after it has reached a state of maturity and vigour, should gradually decline; why, when once an even balance between tissue-waste and restitution is established, it is not maintained indefinitely. How far the failure is due to some inherent tendency, and how far to external influences, is wholly conjectural. Among the most recent hypotheses is one based upon the theory that the various glands, secreting and ductless—and also perhaps some of the tissues—exert some material influence upon the blood, and through it upon the tissues generally, whereby the normal metabolism of healthy activity is maintained; and, conversely, as this influence —effected, as is supposed, through some 'internal secretion,' *i.e.* a secretion which is retained in the organism and is not excreted—fails, so does the general nutrition deteriorate. The treatment of myxœdema by extract of thyroid gland is based upon this theory, and according to Dr. Brown-Séquard the weakness and characteristic phenomena of old age are due to 'a natural series of organic changes and the gradually diminishing action of the spermatic glands and ovaries.' To refer the senile state to an impairment of the trophic influence exerted by the nervous system, or to a diminution in the water contained in the protoplasmic elements of the tissues, or to any other such cause, however true each and all may be so far as they go, only places the difficulty a step farther back, and does not remove it.

Anatomical Characters.—Recent observations, especially those of Sir George Humphry, have shown that many of the morbid conditions which are usually regarded as essential features of advanced life are really manifestations of disease occurring at this period, and do not of necessity pertain to senility, which may supervene and progress to death undisturbed by any actual disease —in short, an old age that is healthy just as any other period of life may be. The term 'involution' has been suggested to express the normal senile changes in the tissues and organs, of which a progressive *atrophy*—a simple diminution of material—is the most universal and characteristic. The degree of wasting varies, but there is a general diminution in body-weight and height, except in persons whose climacteric has been marked by an increase of the adipose tissue, when the total loss of weight may be inconsiderable. Among the organs which exhibit simple atrophy in the highest degree are the brain and spinal cord, the shrinking of the former with increase of the subarachnoid fluid being sometimes very considerable; the generative organs, especially the ovaries, and to a less extent the testes, the uterus, and the mammary glands; the mucous membrane and glands of the digestive tract; the bronchial and vesical mucous membranes; the spleen and lymphatic glands, the latter even to complete disappearance; and the kidneys. A most important change, and one that exerts a very direct influence on tissue-nutrition, is an extensive shrinking or even obliteration of the capillaries in almost all the textures. The skin becomes much diminished in thickness, especially in the papillary layer, the constituent papillæ being very indistinct; and loss of hair and change of colour are well-known features. The senile changes in the skeleton are of peculiar interest. The bones, which in the earliest stages of formation are solid, become, as development proceeds, hollowed internally, by the formation of cancellous tissue and, in the long bones, of the medullary canals. As the absorption of the central part proceeds, the bones nevertheless increase in weight and bulk until maturity is reached, by subperiosteal ossification; but in the decline of life, as this process takes place scarcely at all, and the atrophy continues, the bones, whilst retaining their general size and form, become much thinner, lighter, and weaker. The change takes place especially in the cancellar parts, which are most vascular, and where the agents for absorption are most active—hence the special weakness of the ends of the long bones, and their liability to fracture. The alveolar parts of the upper and lower jaw-bones, consisting as they do chiefly of this loose spongy tissue, are characteristically wanting in the aged; and since these parts carry the teeth, this atrophy of the bone leads to their falling out. The lower jaw is one of the few bones in which an alteration in shape takes place, the ramus and body coming to be more nearly in a straight line, with proportionate widening of the angle. The bone thus resembles the shape it has in the infant, with the difference that it then consists mainly of the alveolar part, whilst in old age it is the denser basal or sub-alveolar part that alone remains. The altered shape of the mandible has been attributed to the loss of teeth causing a deviation in the line of action of the masticating muscles. Sir George Humphry finds no confirmation of the commonly accepted statement that the angle between the neck and shaft of the femur becomes smaller with age. The same observer has drawn attention to two exceptional conditions of an opposite character met with in the skull. One of these occurs as nearly symmetrical areas of atrophy of the outer table and diploë, forming well-marked depressions extending obliquely across the parietal bones, which he is inclined to attribute to 'the pressure of the occipito-frontalis tendon stretched upon, and playing over, the most prominent part of the vertex.' The other condition he has described as a considerable thickening of the calvaria, especially towards the frontal region, with great density of the bone. The explanation of this very anomalous state, so contrary to what takes place in the cranium and entire skeleton generally, is not obvious, though it may be connected with the diminished pressure of the wasting brain. The age at which these changes in the osseous system set in is very variable, but they commonly commence earlier in women than in men. Slight atrophy takes place in the cartilages, costal and articular, the latter accounting for the diminution in height of the old person; but calcification is not invariable, and is indeed evidence of disease. Corresponding to the loss of strength in the bones is an increasing weakness in the power of the muscles, which explains, *inter alia*, the fact that fracture by muscular action is no more frequent in the aged than at other periods of life. It is to the weakening of the dorsal muscles that the stoop of age is attributable.

Associated with this atrophy it is usual to find *degenerations*—fatty, calcareous, or pigmentary—all of which are to be regarded as evidences of deficient nutrition, and may be contrasted with the differentiation and growth which characterise the commencement of life. The arcus senilis, the atheroma and calcareous degeneration of the vessels, the calcification of cartilages, the fatty degeneration of muscular and glandular epithelial tissue, the deposition of pigment in some spots, and the deficiency of the same in the hair and skin of the coloured races, are illustrations of true degenerative changes. Inasmuch, however, as these conditions are frequently wanting even in persons dying at an advanced age, they cannot be regarded as essential characteristics of senility; though it may be admitted that the cause, whatever it be, that determines the above described simple atrophic changes might easily be supposed to favour the closely allied states of degeneration. It might, indeed, be reasonably argued that it is the very absence of these and other degenerative changes which permits the attainment of great age, whilst their occurrence, as is usual, at a somewhat earlier period tends to a rate of mortality below that of these advanced ages.

Another expression of impaired nutrition not so profound perhaps as degeneration, is a fibroid overgrowth in certain tissues, especially the arterial coats, which are often much thickened therefrom, and the prostate gland, which is commonly enlarged in elderly men from this same morbid change—the so-called hypertrophied prostate. The meninges, and capsules of liver and spleen are sometimes thickened from the same cause; and a similar cirrhotic condition may be set up in the kidney and testis.

The blood contains fewer corpuscles and less solid constituents, is more watery, and is said to coagulate more readily. The total quantity is less.

The semen is very frequently wanting in spermatozoa, and contains in their place granular fatty cells, like colostrum-corpuscles, with a few red blood-corpuscles; but this is not invariably the case, for perfect spermatozoa are occasionally met with at an advanced age.

Physiological Characters.—The results of such structural imperfections appear in deterioration of the purely physical, as well as of the specially vital, properties of the tissues. There is an increased rigidity in some parts, as the tendons and blood-vessels; and a diminished cohesion in others, as the nails and bones, which are brittle and easily broken. Perhaps the most prominent and distinguishing mark of old age is a loss of elasticity; the skin, cartilages, blood-vessels, and lungs show this to a very marked extent, in the wrinkled integuments, dilated vessels, and distended air-cells. It has been noticed that this dilatation particularly affects the thin-walled veins, and more especially those which do not run with arteries, are more superficial in position, and are concerned less with nutrition than with the proper return of blood—the 'derivative circulation' of Sucquet. The advantage of this is apparent, for such an arrangement must be a safety-valve in the case of the brain, to which organ there is a liability to determination of blood, and where the vessels are apt to rupture; hence the frequent turgescence of the nose and ears, and development of the veins of the diploë, in the aged. The muscular contractility and nervous irritability are diminished; and atrophy and degeneration of the gland-cells lead to failure in their powers of secretion.

The heart's beat is weak, and frequently intermittent, from defect in rhythmical nervous stimulation; the cardiac sounds are feeble and often altered; and there is a general tendency to venous congestion. The mean rate of pulse after the age of sixty-five years is 75, gradually diminishing to 70.

The tissues, which differ in chemical composition from those of mature life, must in their metabolism form different products of waste; whilst the altered blood, circulating in a restricted area with diminished force, must offer to the organs a different pabulum from that which they have hitherto received, supplied as it is by impaired digestive organs. The enfeebled respiration prevents complete oxidation; and the excretory organs, being less capable, but imperfectly withdraw from the body the results of metamorphosis. The quantity of urine is often diminished to fifteen or twenty ounces *per diem*, in old men enjoying good health. It contains a total amount of solids less than the normal standard, but the urine itself may be relatively of higher specific gravity, and deeper colour, from its diminished quantity.

As the nutritive functions fail, so do those of the neuro-muscular system. The sense-organs imperfectly receive impressions, which are but dimly communicated to the sensorium, whence feebly emanate the impulses needful to determine movements in muscles, the protoplasmic contractility of which is gradually diminishing. Meanwhile, the higher mental qualities, such as memory, judgment, and reason, dependent as they are upon the most perfect nutrition, gradually fail. The opposite conditions of wakefulness and drowsiness are frequently met with, and seem to be due to brain-wasting, as well as to some change in the cerebral circulation.

As a further manifestation of the lowered vitality, recent careful and continued observations have shown that the average body-temperature is slightly lower than it is in adult life, and the power of resisting cold is diminished.

The power of reproduction, lost by women at the climacteric, before the stage of senility sets in, is occasionally preserved by men to an advanced age.

Thus the old man presents a strong contrast in his vitality to that of the child; for whilst the life of the latter is so largely dependent upon, and so readily responsive to, external or peripheral impressions, the former lives more and more within himself; the distinctive animal functions gradually failing, as his existence becomes restricted to the performance of those of self-nutrition. The progressive impermeability of the capillaries, and the lessened vitality of the skin, alike tend to withdraw from the surface towards the central organs the manifestations of life.

Diseases of Old Age.—In a certain number of cases, the progressive deterioration in structure and failure in functional capacity mutually adapt themselves, and produce an old age which may be as healthy as the maturity or childhood may have been. But in the course of the atrophic changes which normally mark this period, the body is liable to certain influences, both intrinsic and extrinsic, which lead to diseases characteristic of this stage of life, as there are those of infancy and puberty. Death from old age, when the organs have gradually and uniformly failed, is not unknown, but the fatal end is more commonly due to some disease, which has either lasted from an earlier period, or is especially the acquirement of this stage.

The maladies particularly characteristic of old age are marked by certain general features, which they owe to that condition of nutrition in which the tissues are at this period. Thus, as a rule, they present but little activity in their progress, or but slight severity in symptoms, though they are none the less likely to bring about a fatal result, from the ill-resisting power of the whole system. Diseases of an acute character are rare at this time, and such as do occur assume an adynamic form, and are very liable to run a most insidious and even latent course. When once established, an illness tends more perhaps towards maintaining an isolated attitude, without those sympathetic disturbances of many other organs so pre-eminently the case in children. The power of reaction possessed by the aged is but very slight; owing to this, diseases readily lapse into a chronic state, or even present a chronic character from the outset, whilst comparatively trifling causes may lead to serious results. The observations of Sir George Humphry, however, go to show that the reparative power even in persons of advanced age is often greater than is supposed, and he adduces well-authenticated cases of complete recovery from severe accidents and illnesses; and in such we may reasonably infer that the degenerative changes are wanting or but very slight.

There is probably no single disease which is met with in advanced age only; rather is it the case that many diseases which prevail at certain periods of life are wanting in old age. The atrophy of every tissue and organ entails a general failure in function; and should this failure predominate in any one system, as may readily follow from a marked degeneration of certain special parts, we have some exception to what may be taken as the normal standard of the senile state, and therefore a disease of it. The same difficulties surround the question, why one set of organs should be affected rather than another, as at other ages; but there nevertheless does exist a preference towards affections of the nervous, circulatory, and respiratory systems. But a very large proportion of old people are entirely free from disease—of 824 persons over eighty years old, 55 per cent. of the women and 35 per cent. of the men were reported to be healthy (Humphry, *Collective Investigation Records*).

Diseases of the brain.—The cerebral lesions may be a general senile wasting and softening, with complete enfeeblement of nerve-function; or of a more localised character, from rupture or occlusion of some vessel.

The liability to venous engorgement is very prone to manifest itself in the brain, and cerebral congestion of varying extent is frequent. The cerebral vessels are especially liable to atheroma, and hence the great frequency of apoplexy in old age. The meninges are free from morbid change beyond thickening, and offer none of the inflammatory conditions so common in early life. Muscular tremors especially involving the head are frequent, and are probably due to wasting of the cerebral cortex. All degrees of deafness and impaired sight are met with.

Diseases of the heart.—The degeneration of the cardiac substance may lead to a state of asthenia, gradually becoming fatal; dilatation of the orifices may be the more prominent lesion, with all the consequent symptoms of obstructed circulation; or they may be constricted, from atheroma or thickening of the cusps or rings. Cardiac dyspnœa and every form of irregularity in cardiac rhythm occur to variable extents.

Diseases of the lungs.—Pulmonary diseases are important, since they are commonly the immediate causes of death in the aged. A bronchial catarrh, or at least a considerable increase in the bronchial secretion, is a normal state in the very old; and this has been regarded as a compensation for the arrested skin-action. The transition from this to severe bronchitis is both easy and frequent, and is favoured by the liability to lung-congestion, and the enfeebled heart-power. Even more serious is a senile form of lobular pneumonia, which seems to be set up in the congested and œdematous areas, possibly as a further stage of the bronchitis. Such pneumonia is of very frequent occurrence, and often requires carefully looking for, since direct symptoms are wanting. When a generally ill-defined illness is present in an old person, this condition should be suspected.

Diseases of the digestive organs.—The digestive organs, supposing they have escaped the dangers of earlier periods, are not often the seat of disease at this time of life. The perversions of function they present, such as constipation and flatulence, may be conveniently comprised under the term 'atonic dyspepsia,' and are mainly to be attributed to deficient muscular power in the alimentary canal, and to a deficiency in the digestive fluids. Nevertheless, a good appetite and very fair digestion are far from being the exception in old people. An acute form of diarrhœa of a dysenteric character has been described as occurring at this period.

Diseases of the skin.—The skin, which suffers so much diminution in nutrition and thickness, often exhibits as a result marked changes in sensibility, even to the existence of an intolerable pruritus, no cause for which is visible. The scratching which is resorted to for relief sets up a prurigo which intensifies the discomfort. The unhealthy integument offers a very favourable nidus for pediculi, and phthiriasis is accordingly a common senile affection.

Diseases of the urinary organs.—The most characteristic appearances in the senile kidney are those of a diffuse interstitial nephritis, with progressive atrophy of the tubes, similar in many respects to the 'gouty kidney,' but not, like it, associated with cardiac hypertrophy. The urine is in such cases albuminous, but the general symptoms of Bright's disease met with in middle life are usually wanting. Glycosuria, often intermittent, is of very frequent occurrence in old people; but is rarely attended by the constitutional disturbance of diabetes. Notwithstanding the very imperfect action of the skin and kidneys as excretory organs, diseases directly attributable to non-elimination of waste products are not characteristic of old age, except, of course, so far as helping in the general degeneration.

Irritability of the bladder, or even vesical catarrh, is very common in old men, being largely determined by the enlargement of the middle lobe of the prostate, but the hypertrophy of the organ may exist to a considerable extent without causing any symptoms until the mid-lobe is affected. Both retention and incontinence of urine follow, from the diminished tone of the viscus.

Vascular disease.—The frequency of atheroma of the vessels and thickenings from peri-arteritis has been alluded to. The tendency of the blood to coagulate, added to the opportunities it has for stagnating in the dilated channels and cavities of a weak heart, makes thrombosis and embolism very liable to occur in the senile state. The result of the obstruction is gangrene (*gangræna senilis*), which is readily established in tissues the capillaries of which have wasted or are obliterated, with corresponding deficiency of nutrition.

Arthritic lesions.—Very few old people escape chronic rheumatism in one or other of its many forms, though it may be questioned whether the constant pains complained of are not oftener due to neuritis than actual rheumatism. The fibrous tissues of the joints, fasciæ, and tendons are thickened, and less flexible from lack of moisture, with the result of producing that stiffness of the limbs so characteristic of the aged. The pain is rarely acute, but it is lasting, and aids in bringing about the general deficiency of motor power. Renal disease is to be found in many of these cases. True gout is scarcely a disease of old age, though often continued on from an early period of life.

Scrofula, Cancer, and Syphilis.—Sir James Paget and recently Mr. Howard

Marsh have described a senile form of scrofula occurring in people over sixty years of age, in whom the constitutional signs may have appeared in early life, with almost complete freedom during maturity. Marked evidences of this affection have been seen for the first time in persons over seventy-five years of age. The general features of this condition are similar to those in childhood, but slower in their course, more complete in the degeneration produced, and far more resistant to treatment. The cancerous and syphilitic cachexiæ very rarely manifest themselves for the first time in old age.

TREATMENT.—Old age itself, as a period of life, is clearly no more to be treated as a state of disease than life at any other stage. But regarded as a marasmus or cachexia, it has been sought to avert it as long as possible, or mitigate its effects; and for the attainment of longevity many means have been proposed, though as yet without any reliable result, the most diverse plans having been equally successful or futile. *See* PERSONAL HEALTH.

Based upon the hypothesis above mentioned, Dr. Brown-Séquard claims that much benefit to old men has followed the daily subcutaneous injection of a milligram of a watery extract of the testis of an adult guinea-pig filtered through a Pasteur filter. Others have affirmed the same, but further confirmation is wanting.

It is unnecessary in the present article to explain the treatment of the diseases of old age, as appropriate remedies are set forth under the special headings. It is sufficient here to indicate that, whatever may be the malady, and whatever be the treatment pursued, it must not be forgotten that we are dealing with organs in which the structure is deteriorating and the vitality of which is failing, and that all measures of a depleting or depressing character must be avoided. The feeding of the aged, therefore, becomes a matter of the greatest importance. Speaking generally, the food should be of the most nutritious character, and given in small bulk and frequently. The old person, whether ill or well, should not be allowed to go for many hours without food, as is too often the case, through the night. A light meal in the small hours of the morning is of the greatest benefit, and goes far to counteract the wakefulness so common at this period of life. In view of the presumably deficient power of the digestive juices, some of the artificial semi-digested foods may be advantageously employed, or the active principles of the digestive secretions administered with the food. The need for alcoholic stimulants is usually imperative, especially for those who have always taken them, but they should only be given with other food. Medicinal tonics are seldom of the same benefit that they are at earlier ages; probably strychnine is of most value. A daily aperient, such as two grains or more of the extract of cascara sagrada, is frequently necessary; and it is generally undesirable to forbid any habit, whether of drugs, food, or smoking, which has been previously long continued. Among the most important hygienic indications is the maintenance of warmth. A fall in temperature both lowers the general vitality, and tends to establish a local disease, and its effects are more easily prevented than cured when once established. Warm clothing is therefore indispensable, and cold feet should be specially guarded against. Equally prejudicial with cold and damp is exposure to high winds, which is frequently responsible for a fatal pulmonary attack.

W. H. ALLCHIN.

SENSATION, Disorders of.—The sensory apparatus—consisting of, 1st, a peripheral end-organ for receiving impressions; 2nd, an afferent nerve which conducts them; and, 3rd, a ganglionic nerve-centre which undergoes a change, perceived by the consciousness as a feeling—may be disordered in various degrees. The lesion occasioning the disorder may exist at any point of the apparatus. As regards (A) the nerves of *special sensibility*—the olfactory, optic, auditory, and gustatory, the terms *hyperæsthesia* or *excess of feeling*, and *anæsthesia* or *want of feeling*, are applied respectively to conditions of exaggerated or defective sensibility. In reference to (B) the remaining sensory nerves, the perceptions produced by which are known as *common sensations*, the same terms are used, as well as certain others, indicating perversions of sensibility, which can scarcely be included in this simple classification. There is a good deal of confusion existing in the employment of these terms, and their use can only be defended on account of their possessing a certain amount of convenience for purposes of distinction. *Pain* is separately described. *See* PAIN.

A. **Special Sensibility.**—1. *Olfactory hyperæsthesia.*—This is probably always of central origin. It is shown by subjective sensations of strong, usually disagreeable odours; and occurs in the insane, the epileptic, the myxœdematous, and the hysterical. *See* OLFACTORY NERVE, Morbid Conditions of.

2. *Olfactory anæsthesia.*—SYNON.: *Anosmia.*—This is occasionally congenital, but otherwise rare, and (unless where the mucous membrane of the nares has been destroyed by ulceration) is usually dependent on disease of the brain, or growths upon the olfactory lobes. It may also arise from laceration of the olfactory filaments, as a result of *contre-coup* in blows upon the occiput. There may be complete anosmia, whilst the common sensibility of the nares is

retained. On the other hand, in peripheral lesion of the fifth nerve there may be partial loss of smell, associated probably with impaired nutrition of the nasal mucous membrane. Integrity of the mucous membrane is apparently necessary (probably for mechanical reasons) to the perfect functioning of this special sense. It sometimes happens that there are subjective sensations of bad odours, where the power of perceiving objective odours is absent. Anosmia may occasionally result from a long-continued nasal catarrh, and is then probably connected with some modification of the mucous membrane which receives olfactory impressions.

3. *Optic hyperæsthesia.*—This disorder is marked by the production of luminous and chromatic sensations, independent of external influences. The disordered function may be caused by, or associated with coarse disease of the brain, over-stimulation of the optic nerve by light, insanity, delirium tremens, epilepsy, or hypochondriasis. Spectra of luminous angularities resembling the lines of fortifications, showers of sparks, or bright colours, occur sometimes in the course of migraine. A subjective sensation of colours (most often red) occurs occasionally as the aura of an epileptic fit.

4. *Optic anæsthesia.*—This may depend upon changes in the retina, in the trunk of the optic nerve or tract, or in the nervous ganglia which form its central termination. The terms *amblyopia* and *amaurosis* are usually employed to designate different *degrees* of imperfect vision, the latter the most advanced. *Amblyopia* is often met with in the disused eye in cases of strabismus, without any structural change being necessarily capable of detection by the ophthalmoscope, such as would explain the loss of nervous sensibility. In some instances, however, of this kind, the optic disc has a shrivelled, ill-nourished look; it is dull; and the retinal vessels are small. Amblyopia may consist in a general obscurity of vision, a deficiency in the power of definition, a contraction of the field of vision, or anomalies of colour-vision. It occurs occasionally in hysterical hemianæsthesia, and may then be limited to one eye, on the same side as the other defects of sensation; it is frequently the prelude of an epileptic fit.

Ophthalmoscopic examination of the eye, together with the patient's general condition, will usually reveal the cause with facility. *Amblyopia* may be a symptom of *optic neuritis.* The optic neuritis will probably be dependent upon tumour, abscess, aneurysm, or some coarse change within the cranium, such as meningitis. Or there may be *neuro-retinitis*, in which the retina still more largely participates in the inflammatory changes, a condition liable to be induced, amongst other causes, by syphilis, diphtheria, or over-lactation. But the symptom is frequently absent in both conditions up to a certain point, the patient being able to read small print even when the pathological changes are strongly pronounced. Sometimes amaurosis also occurs in diabetes, from retinal changes. *See also* NYCTALOPIA.

5. *Hemiopia.*—This is a condition in which a half of the field of vision—usually a lateral half—is cut off. It may depend upon coarse disease, such as a tumour or clot, pressing upon an optic tract. It occurs sometimes in hemiplegia, complicated with paralysis of the third nerve opposite to the side on which the limbs are paralysed, and depends then upon lesion of the corresponding crus cerebri. It is frequently seen in a hemiplegia which is attended with strongly marked and persistent anæsthesia of the affected limbs, and dependent upon coarse disease in the neighbourhood of the optic thalamus. Lesion of the cortex cerebri in its posterior portion may be the cause. It is not rarely met with also, but only as a transient symptom, in megrim. It is occasionally, but only seldom, met with in hysteria.

6. *Auditory hyperæsthesia.* — In certain states of nervous exhaustion, in fever, and sometimes in hysteria and hypochondriasis, sound-producing vibrations painfully affect the auditory nerve. It is doubtful whether the proper function of the nerve is ever really much intensified. At a certain stage, however, of anæsthetisation by ether, chloroform, or other agent, sounds appear to be greatly exaggerated. Pain, rather than an increased power of hearing, is usually the result of hyperæsthesia of the auditory nerve.

7. *Tinnitus aurium.* — This is almost always subjective, although it must be borne in mind that an aneurysm in the neighbourhood of the temporal bone may occasion tinnitus. The sounds may be of various kinds—rumbling, hissing, musical, roaring, hammering—and may depend either upon some irritation of the auditory nerve itself, or upon affection of some other part of the organ of hearing. It seems probable that affection of any portion, from the external auditory meatus to the Eustachian tube, may give rise to the condition. The difficulty of diagnosing the seat of the affection is very great.

Tinnitus aurium may also be dependent upon some altered condition of the walls of blood-vessels, in connexion with anæmia or cerebral congestion. It is often produced by large doses of quinine. In certain cases it is of central origin. The sensation of a loud noise occasionally marks the commencement of an epileptic seizure or of a syncopal attack. Deranged digestion may produce it. There may be subjective sensations of sound in an ear which is quite deaf to external impressions.

It is not uncommonly found to be dependent simply upon an accumulation of wax in the external auditory meatus. Tinnitus aurium is very often associated with vertigo. Not uncommonly occurring in persons of gouty habit, it is possibly sometimes caused, in such cases, by a deposit in a joint of the ossicles, causing inflammation and stiffness. It seems likely that it is sometimes due to irritation of the auditory nucleus in the medulla oblongata by uric acid or some such agent.

Tinnitus aurium is always a distressing, and often an intractable affection. Where it depends upon some anæmic condition, it is most likely to be cured by remedies appropriate to this state. Of course, if caused by accumulation of wax, the removal of this is a simple remedy. Subjective sensations of sounds, especially of voices of men or animals, occur frequently in various forms of insanity, in which case they are spoken of as hallucinations.

8. *Auditory anæsthesia.*—This may be due to disease or suspended functional activity of the auditory nerve; and probably, in some cases, to lesion of the superior temporo-sphenoidal convolution of the brain—Ferrier's centre for hearing. Hardness of hearing and deafness are the forms taken by varying degrees of acoustic anæsthesia. The cause may be disease in the osseous labyrinth of the bone itself or its lining membrane, or tumours which cause compression and atrophy of the nerve, basilar meningitis, extravasations, or new-formations. Syphilis may bring about acoustic anæsthesia by causing periostitis and consequent pressure upon the auditory nerve. A most fruitful source of deafness is disease of the temporal bone from scarlatina. In some instances the auditory nerve is atrophied, as part of that generalised disorder of the sensory nervous system which is called tabes dorsalis. In cases of so-called nervous deafness inquiry should be made as to the occurrence of 'lightning pains,' and the state of the patellar tendon reflex should be investigated.

Disease of the pons Varolii or medulla oblongata may occasion deafness, through lesions affecting the nucleus of the auditory nerve or the commencement of its trunk. It is more likely than not that in these circumstances the auditory nucleus would not suffer alone, but that there would be evidence of other cranial nerves being involved, which would aid the diagnosis.

9. *Gustatory hyperæsthesia.* — This disorder occurs probably only in the course of mental and epileptic disorders, and in myxœdema where the subjective sensation of a taste (most often perhaps of an offensive character) is sometimes complained of. Such a condition is of central origin.

10. *Gustatory anæsthesia.*—This is of frequent occurrence. There may be a total inability to appreciate the taste of substances applied to the tongue, or more or less delay in their recognition. It is sometimes observed in cases of peripheral paralysis of the facial muscles, and then depends upon the lesion of the portio dura involving also the chorda tympani. It is the anterior portion of the tongue which, in such circumstances, exhibits the loss of function. So also in disease of the trigeminus in the floor of the skull, there is frequently gustatory anæsthesia in the anterior portion of the tongue. The glosso-pharyngeal nerve by its terminal branches presides over the sense of taste in the posterior third of the dorsal aspect of the tongue. Disease or lesion of the trunk of this nerve destroys the sense of taste in this region. *See* TASTE, Disorders of.

The disorders of special sensation which have been described are so bound up with lesions of the various nerves subserving the functions, or of the nervous centres, that they can only be considered from an ætiological and therapeutical point of view in connexion with these. Reference must, therefore, be made to the articles devoted to such lesions.

B. **Common Sensibility.**—Disorders of those centripetal nerves, the perceptions produced by which are known as 'common sensations,' are considered under the head of TOUCH, Disorders of.

T. BUZZARD.

SEPTICÆMIA (σηπτικός, putrid; and αἷμα, blood).—SYNON.: Fr. *Septicémie*; Ger. *Septicämie.*

DEFINITION.—A disease due to the entrance into the blood of the products of putrefaction.

DESCRIPTION.—When putrefaction occurs in a wound there is an active development of bacteria, and this is accompanied by the production of a virus which, gaining entrance into the blood, produces symptoms of blood-poisoning of a severity proportioned to its dose and virulence.

If the dose of the poison be a large and fatal one, its absorption is quickly followed by rigors and elevation of the temperature, to which may be added sweating, vomiting, and diarrhœa. The pulse soon becomes rapid and feeble, delirium and collapse ensue, the temperature rapidly descends to below the normal, and the circulation fails.

Post mortem we find general congestion of the viscera, subserous ecchymoses, especially beneath the endocardium, and marked injection of the vessels of the alimentary canal. The blood is darker than natural, the corpuscles collect in irregular masses, and many of them are undergoing disintegration and solution.

If the dose of the virus be of less severity, the rise of temperature is succeeded by a more gradual fall; the sweating and diarrhœa diminish; and the patient is left weak and anæmic, but may eventually completely recover.

Cases of every degree of severity are met with, varying with the amount of the poison absorbed: some rapidly fatal, some of such slightness that they would probably be overlooked but for careful thermometric observations.

But the duration of the disease depends chiefly upon the repetition or continuance of the entrance of the poison, for the poison does not multiply, and, unless it continues to be produced and absorbed, the symptoms to which it has given rise come naturally to an end.

In many cases, therefore, the symptoms of septicæmia consist of a repetition of those described above, corresponding with successive doses of the poison—repeated rigors, irregular elevations and depressions of the temperature, frequently recurring diarrhœa, steadily increasing anæmia and emaciation—until either the source of the poison is removed, or the patient is exhausted by fever and diarrhœa; a low pneumonia, a bedsore, or some other complication, bringing the disease to a fatal end. Such cases may continue for an indefinite time without the occurrence of any secondary deposits, such as are seen in pyæmia; and in those who recover, the most marked effect of the disease is the condition of extreme anæmia and muscular weakness in which the patient is left.

Prevention and Treatment.—The septic poison requires for its production the presence and development of bacteria; and the septic bacteria need for their life and multiplication a lowered vitality or a damaged condition of the tissues. The blood of a healthy person does not contain such bacteria or their germs, which must therefore gain entrance to the body from without. Evidently, therefore, the chief measures for the prevention of septicæmia are: (1) scrupulous cleanliness in the treatment of wounds, for the avoidance of the introduction of septic germs and of the condition of wound which is favourable for their development; (2) the use of antiseptics for the destruction of such germs as may accidentally be present; and (3) the healthiest possible environment for the sick and injured, so that the body may be maintained at the highest level of vitality, and therefore in a condition of resistance to adverse influences, and also that the patient may be defended as far as possible from everything tending to the development of the septic process.

When, however, septicæmia is once established, our efforts should be directed, firstly, to the removal or destruction of the source of the poison; secondly, to the maintenance of the powers of the patient till the effects of the poison are at an end.

For the first purpose, the wound, if there be one, must be thoroughly cleansed and disinfected, and by the careful use of antiseptic dressings an aseptic condition established and maintained. If the source of the poison be an inflamed or necrosed bone, the removal of the bone, or of the limb, must be considered. If the disease originates in inflammatory products confined within one of the cavities of the body, as the uterus, the pleura (empyema), or the peritoneum, free drainage must be provided, and, if this is insufficient, antiseptic irrigation should be used. If foul suppuration is going on within the body, as, for instance, an abscess of the lung, or a pelvic abscess communicating with the bowel, an attempt should be made to provide a free exit for the matter, and to bring antiseptics into contact with the infected surface. The patient should be placed, if possible, in a large, well-ventilated room, from which all sources of contamination are carefully excluded. Plenty of nourishing and easily assimilated food should be administered, together with whatever stimulant seems called for.

Of medicines, sulphate of quinine is by far the most useful, and seems often to be productive of marked benefit. *See* Pyæmia.

J. Warrington Haward.

SEPTUM CORDIS, Deficiency of. *See* Heart, Malformations of.

SEQUELÆ (*sequor*, I follow).—Consequences or sequels. This word is applied to symptoms or morbid conditions which either remain or supervene after various diseases have run their course; such as renal disease after scarlet fever, paralysis after diphtheria, or cardiac disease after acute rheumatism. *See* Disease.

SEROUS FLUID
SERUM }.—In physiology the liquid portion of the blood, which separates after coagulation, is named the *serum*, and this is taken as a type of fluids of more or less similar composition, consisting of a watery solution of albumin with certain salts. In pathology we have to deal with serum outside the blood-vessels, either as a mere dropsical accumulation, or as an inflammatory effusion. It may be thus met with in the cellular tissue under the skin or a mucous membrane, and in other parts; in serous cavities; in certain organs, as the lungs and the ventricles of the brain; or as a discharge from the surface of the skin, as in cases of eczema. Its precise composition varies considerably under different circumstances. Clinically serous fluid is, as a rule, of chief importance on account of its mechanical effects, when it accumulates in quantity in various parts, and these effects may be most serious. Its presence can usually be detected by direct objective, or more methodical physical examination. The treatment required will be that either for dropsy or that for inflammation, modified by local indications, according to the principles laid down in other special articles.

Frederick T. Roberts.

SEROUS AND FIBRO-SEROUS MEMBRANES, Diseases of.—SYNON.: *Maladies du Système Séreux*; Ger. *Krankheiten der Serösenhäute.*—These constitute an important class of diseases; and although they are discussed under the headings of the several serous membranes, it will be advantageous to consider them generally, according to the plan followed in the case of the mucous membranes. Serous membranes line closed cavities, except in the case of the peritoneum in the female, which communicates with the uterus through the Fallopian tubes, and thus with the exterior of the body. They consist of a basement-membrane, covered with epithelium, usually of the scaly variety, and a subserous cellular tissue underneath. In addition to their more obvious function, of allowing free movement for organs, they are intimately connected with the absorbent system, the vessels of which freely open on their surfaces. Fibro-serous membranes constitute a variety, in which there is an outer fibrous covering, lined by a serous layer, and of which the pericardium is an example. The nature and causes of the several diseases of serous membranes will now be pointed out.

1. **Injury.**—The serous membranes are liable to be injured from without, chiefly as the result of wounds penetrating the cavities which they line, but also by fractured bones, especially in the case of the ribs and skull. It is highly probable that a severe external contusion may affect an underlying serous membrane. Another important cause of injury to these structures is some perforation or rupture taking place within the body (*see* PERFORATIONS AND RUPTURES). They are frequently more or less injured in various operations. Any kind of injury to this class of membranes was formerly regarded with great dread, and operations in which they were in any way interfered with were considered highly dangerous; more recent experience has, however, shown that mere damage to a serous membrane is not serious in itself. More or less grave consequences are liable to follow, from hæmorrhage; from the admission of air, especially if highly charged with septic matters; or from the escape of solid or liquid materials into a serous cavity. In addition to their direct effects, these sources of irritation often set up inflammation, which may prove fatal.

2. **Inflammation.** — Serous inflammations are of common occurrence; and, without entering into details, their causes may be thus summarised: (*a*) Some injury from without, under which may be included that set up by fractured bones. (*b*) Perforations and ruptures within the body, the inflammation being then mainly due to the materials which gain access into the serous cavity. (*c*) Mechanical or chemical irritation of any kind. Many cases belonging to the former groups would come under this variety; as well as those in which inflammation is set up by necrosed bone, diseased organs, and tumours, or as the result of over-distension of a serous membrane. This class would also include cases in which a serous inflammation is purposely excited by the injection of certain chemical irritants. The occurrence of peritonitis from the entrance into the peritoneum of noxious materials from the uterus along the Fallopian tubes may also be mentioned here. (*d*) Morbid growths in connexion with a serous membrane, especially tubercle and cancer. These deserve separate mention, though they likewise act by causing local irritation. (*e*) Extension of inflammation from other structures. In this way the morbid process may pass from one serous membrane to another. Some forms of inflammation may probably extend to the serous membranes through the channel of the lymphatics. (*f*) Certain general states of the system, in connexion with low fevers, pyæmia, Bright's disease, and other affections. (*g*) Causes acting upon the whole body from without, such as cold, when the inflammation is often spoken of as *idiopathic.* Different serous membranes present different degrees of liability to be affected by one or other of the causes mentioned; and these produce different effects, according to their nature.

Cases of serous inflammation present much diversity as regards their severity and rate of progress, and the morbid changes are thus materially influenced in their character, as well as by the cause of the inflammation, the particular membrane affected, and other circumstances. In general terms they may be grouped as *acute*, *subacute*, and *chronic* in their origin and course; but those which are more or less acute at the outset usually leave behind permanent morbid conditions. Taking an ordinary case of an acute serous inflammation, running a regular course, it presents the following more or less obvious stages in regard to its anatomical characters: (*a*) Increased vascularisation, with consequent redness of the membrane, and sometimes small hæmorrhages, accompanied with dryness, loss of polish, opacity, and swelling. (*b*) Deposit of organisable lymph or fibrinous exudation upon the surface, containing a variable number of cells, mainly leucocytes. (*c*) Effusion of fluid into the serous cavity, more or less of the nature of serum, but also containing a variable proportion of fibrinogenous elements and cells. (*d*) Absorption of the fluid. (*e*) The formation of fibrous thickenings, or of adhesions, bands, or agglutinations between the opposing surfaces of the serous membrane.

Such being the usual course of events in a typical case of serous inflammation, it must suffice to point out, without entering into any details, some of the more common variations. There may be little or no fluid, the exudation being the prominent morbid product. This exudation varies much in its quality, and may be of a very low, unorganisable type, resembling in some instances thick pus. Again, a fluid effusion is, under certain circumstances, liable to become sero-purulent or actually purulent, or it may be so from the first. In other conditions it is hæmorrhagic. Its quantity is very variable. There is a class of cases in which the prominent morbid change is the accumulation of a serous effusion, not uncommonly in large amount, and it may take place very gradually and insidiously, or, on the other hand, with remarkable rapidity. The slow and chronic formation of localised adhesions is very common in connexion with certain serous membranes, without any clinical indications of their development. Gas may be present in serous cavities in cases of inflammation, and then results from decomposition of the effusion, unless it should have been introduced from without. In rare instances pus collects in the subserous tissue; or actual destruction or gangrene of the involved tissues may occur.

With regard to the extent of the disease, cases of serous inflammation are usually divided into *general* or *diffuse*, and *local* or *circumscribed*, though the former terms do not necessarily imply that the whole of a serous membrane is implicated. As a rule the effusion is freely movable in the cavity, but it may be more or less limited by former adhesions, or even completely loculated and encysted. Serous inflammations are often accompanied with changes in the organs and structures which they cover, these being either the cause or the effect of the inflammatory changes. Moreover, an effusion, especially if purulent, may open in various directions, and thus originate secondary consequences more or less serious. Not uncommonly it has to be removed by operation.

The following appear to be the chief microscopical changes which take place in connexion with an inflamed serous membrane. The epithelium undergoes marked alterations, its cells usually becoming enlarged and swollen, granular, and cloudy, while its nuclei divide and multiply, and active proliferation goes on. In low forms of inflammation they merely undergo fatty degeneration and destruction, and are shed abundantly. A coagulable fluid escapes from the blood-vessels, and migration of corpuscles also takes place. The cells in the substance of the serous membrane, and the connective-tissue corpuscles, proliferate more or less. Vascular granulations often form on the surface, which are believed to be of much service in absorbing the effusion, as well as subsequently in forming adhesions. Pus-cells are derived from the epithelium, and from leucocytes. Adhesions ordinarily result from the development of the cellular elements in the exudation, the fibrinous material undergoing fatty degeneration; after pus is formed they originate by granulation, and are then likely to be thicker and firmer. In these adhesions blood-vessels, elastic fibres, lymph chambers, and even nerves may ultimately be developed.

3. **Dropsical Effusion.** — The serous cavities are often the seat of a mere dropsical accumulation, owing to the escape of fluid of a more or less serous character from the vessels. It may be in very large quantity, and collect either rapidly or gradually. Sometimes it is not easy to draw the line between an inflammatory and a dropsical effusion; and it is probable that the latter, when very abundant, by distending a serous membrane, may really set up a secondary inflammatory condition. The fluid is occasionally blood-stained or milky in appearance. The condition may be entirely local, or a part of a more or less general dropsy. It may arise from: (*a*) Local obstruction to the venous circulation, which is best exemplified by ascites associated with portal obstruction. (*b*) General venous obstruction in certain cases of cardiac and pulmonary disease. (*c*) Bright's disease. (*d*) Chronic adhesions and thickenings originating in past inflammation; and morbid growths, such as tubercle or cancer. These probably act mainly by pressing upon the small vessels. (*e*) Possibly exposure to cold, sudden suppression of chronic skin-diseases, and other causes which are supposed to originate active internal congestion.

4. **Hæmorrhage.**—As has been already stated, more or less blood, or its colouring-matter, may be present in inflammatory or dropsical effusions in serous cavities. As a distinct morbid condition, hæmorrhage into these spaces may be due to: (*a*) External injury. (*b*) Rupture of an organ, whether healthy or diseased. (*c*) The bursting of an aneurysm. (*d*) The rupture of vessels in connexion with some morbid growth, especially cancer. (*e*) Purpura and scurvy in exceptional cases.

5. **Accumulation of Gas.**—This condition, in connexion with serous cavities, may result from: (*a*) Decomposition of inflammatory products, or of gangrenous materials. (*b*) Perforation or rupture of a hollow organ containing air or gas, whether due to external injury, or originating from within. This accounts for most cases of escape of air into the pleura from the lung, and of gas from the intestine into the peritoneum. (*c*) Transmission of gas through the walls of a hollow viscus into a serous cavity, which sometimes happens in the case of the intestine. The gas varies much in its composition, according to the cause of its presence, and its seat. In pneumothorax

it is usually modified air; in pneumo-peritoneum it is offensive and fœtid. Not unusually the gas is associated with inflammatory effusion or other materials; or it may set up inflammation, and thus cause effusion.

6. **Foreign Materials.**—Various objects may be found in serous cavities, either introduced from without, as the result of injury; or having entered from internal organs, especially in the case of the peritoneum. Amongst others may be mentioned dirt, bullets or shots, food, fæces, urine, worms, and calculi. These are very liable to set up inflammation, often of a very severe and dangerous character.

7. **Morbid Growths.** — Tubercle and cancer are the two important growths which may be found associated with serous membranes. In the folds of the peritoneum accumulation of fat often occurs. Amongst rare morbid formations may be mentioned hydatids; other cysts of different kinds; fibromata; myxomata; and remnants of blood-clots. They may give rise to inflammation or mere serous effusion.

8. **Malformations.**—The serous membranes sometimes present unusual arrangements, especially the peritoneum, and these may possibly become of clinical importance.

SYMPTOMS.—The clinical phenomena which are associated with diseases of serous membranes come within well-defined limits, and can be readily understood and appreciated, as the following outline will show.

1. *Morbid sensations.*—Pain is usually a prominent symptom in acute serous inflammations. It is not uncommonly very severe; variable in its character, but often sharp and darting; subject to exacerbations; and increased by any movement or action which disturbs the inflamed membrane. Where the membrane can be affected by pressure, as in the case of the peritoneum, marked tenderness is observed, and it may become extreme. It must be remembered, however, that pain is by no means a necessary accompaniment of acute inflammation of a serous membrane. In connexion with adhesions and thickenings, painful, dragging, or other sensations may be experienced, owing to the implication of branches of nerves, and other causes; and also in other conditions associated with chronic inflammation. Another kind of morbid sensation, often felt in diseases of serous membranes, is that of distension or fulness, due to various accumulations in their cavities.

2. *Effects on neighbouring structures.*—These account for most of the prominent symptoms associated with diseases of serous membranes. (*a*) Acute inflammation will at first cause irritation of certain muscular organs, such as the intestines, bladder, or heart, and thus excite or otherwise disturb their actions. A similar effect is liable to be produced on the brain and spinal cord. Subsequently these organs tend to become weakened or even paralysed, owing to their tissues being involved in the inflammatory process; and thus striking or even dangerous symptoms may arise. (*b*) The various accumulations in serous cavities produce more or less mechanical effects, often of great importance, especially if the accumulation takes place rapidly. The most evident are distension of the walls of cavities lined by serous membranes; compression of organs and tubes, as of the lungs; displacement of various structures; and embarrassment of the action of organs, such as the heart and lungs. In these several ways not only may subjective sensations be produced, but different objective phenomena, which may prove very serious, or even fatal. In the case of inflammation of the cerebral membranes, lymph may affect important nerves by enclosing and compressing them. (*c*) Another important class of symptoms are those due to the effects of adhesions, agglutinations, thickenings, or morbid growths in connexion with serous membranes. Thus, organs may be fixed in abnormal positions, their actions interfered with, different structures directly pressed upon, or hollow organs strangulated and obstructed. *See* ADHESIONS.

3. *Ruptures and discharges.* — Accumulations in serous cavities may rupture in various directions, and in this way originate symptoms. If they burst internally, they will also probably set up secondary lesions, with their corresponding phenomena. When liquid accumulations open into organs which have an external communication, such as the lungs or intestines, they are discharged through the corresponding channels. They may also burst externally, either directly, or after having first made their way into the subcutaneous tissue.

4. *Physical signs.*—These are of great importance as clinical indications of morbid conditions of most of the serous membranes, of which they may be the only evidence. They are described in other appropriate articles, and it must suffice to state here that they reveal one or other of the following conditions: (*a*) Some deposit upon, or roughness of, the surfaces of the membrane, associated with inflammation or morbid growths. (*b*) Accumulation of a fluid, of whatever kind, and whether freely movable in the cavity or localised. (*c*) A collection of gas, or of gas and fluid together. (*d*) Adhesions or agglutinations. (*e*) The presence of solid infiltrations or masses, due to inflammatory thickening, or to morbid formations, especially cancer. (*f*) Physical effects produced on organs by various abnormal states of the serous cavities or structures.

5. *General symptoms.* — The system is liable to suffer in different ways in cases of

disease of serous membranes. Thus syncope, shock, or collapse may occur in connexion with injuries and hæmorrhages. Inflammation causes pyrexia, usually varying much in degree, but in some instances very high. Septicæmia or pyæmia may arise from the absorption of septic inflammatory products; and collapse occurs in many cases of peritonitis. Signs of the general cachexia may be present in cases of cancer or tuberculosis.

Treatment.—It is scarcely practicable to give any serviceable general outline of treatment directed to diseases of serous membranes, this being so much influenced by a variety of circumstances. In the large majority of cases the measures adopted have some relation to acute inflammation, being intended either to prevent, limit, or subdue this process; to get rid of its products, either by absorption or in other ways; to obviate or relieve its effects upon organs and other structures; to alleviate symptoms; and to affect the general condition. Attention may also have to be directed to the after-effects of inflammation, in the way of adhesions, or to similar conditions arising from chronic inflammation. In a considerable group of cases the object of treatment is to endeavour to remove accumulations, especially of fluid, from serous cavities, whether of inflammatory or other origin. For this purpose it is not uncommon at the present day to resort to operative interference, by means of aspiration, tapping with the trocar and cannula, and other methods. General and local rest are often of much service in the treatment of morbid conditions connected with serous membranes; and local applications are also frequently useful for various purposes. Bleeding, either general or local, has been, and is still, extensively practised in the treatment of serous inflammations, and also the exhibition of calomel and opium; but, in the writer's opinion, the routine adoption of this line of practice cannot be too strongly deprecated. Medicines and local measures which tend to promote absorption are often of decided value, especially in the case of inflammatory or dropsical effusions.

Frederick T. Roberts.

SERPIGINOUS (*serpo*, I creep).—This term is used in connexion with certain morbid conditions, such as ulcers or eruptions, when they spread in a creeping manner.

SETON, Use of.—A method of counter-irritation, which consists in the insertion of a tape or cord beneath the skin. *See* Counter-irritants.

SEVENTH NERVE, Diseases of.—*See* Facial Paralysis; Facial Spasm; Hearing, Disorders of; Salivation; and Taste, Disorders of.

SEVILLE, in Spain. — A variable, rather bracing, inland winter climate. *See* Climate, Treatment of Disease by.

SEXUAL FUNCTIONS IN THE FEMALE, Disorders of. — Introduction.—The influence of the sexual functions on the general health is alluded to in the article Puberty, Disorders of. But, as the ætiological importance of the reproductive system is by no means limited to that period, we may here briefly consider the effect of sexual disorders generally on the bodily health.

The connexion between female sexual disorders and some derangements of the general health hardly admits of any satisfactory explanation beyond their dependence on reflex action originating in utero-ovarian irritation. Long, however, before this doctrine was applied to these complaints, their existence in connexion with uterine and ovarian disorders was well recognised, and was ascribed by old writers to what they termed the *consensus nervorum*, or sympathy, by which, as Prochaska says, 'the operation of a stimulus is not limited to the nerves immediately irritated, but is extended to distant parts in known or unknown connexion with the irritated nerves.'

The remarkable difference in the constitutional sympathies with sexual disorders in the opposite sexes, is accounted for by the comparatively subordinate character of the male reproductive organs. In the female, on the contrary, the utero-ovarian functions are connected with every vital action, from the evolution of puberty until the climacteric period, which terminates her distinctive sexual or reproductive life, is passed. Woman is therefore always liable, as Dr. Storer observes, 'to a host of diseases peculiar to her sex, to which we find neither homologue nor analogue in man.'

Ætiology.—First, with respect to the effect of the general health in the causation of sexual disorders in women, there can be no doubt that these are in many cases the result of some constitutional diathesis.

Gout, rheumatism, struma, neuralgia, and secondary syphilis should be recognised as amongst the constitutional causes of chronic uterine or peri-uterine disease.

Results.—We turn next to consider the converse question—the effect of sexual disorders on the bodily health. In many instances, the local symptoms of disease of the uterus, ovaries, and Fallopian tubes attract so much attention, that the practitioner may neglect the constitutional conditions with which the local sexual disorders are connected. Thus, derangements of the catamenial function are generally associated with the nervous complaints of women. Many forms of hysteria, and the morbid excitability and perversion of the natural feminine instincts, without any tangible delusion or perceptible affection of the intellectual powers, which are so frequently met with, are thus conjoined with amenorrhœa or dysmenorrhœa. The connexion between hysteria and uterine or ovarian disorders is too obvious to call for any notice here (*see* HYSTERIA; and INSANITY, Varieties of). In the present article a few of the principal disorders which may thus originate in sexual disturbances will be briefly noticed.

Epilepsy.—Epilepsy in women is very often symptomatic of uterine or ovarian disorder.

Perversions of tastes and temper.—The influence of the sexual system in the causation of nervous disorders is well illustrated by those strange alterations in tastes and dispositions, that irritable condition of mind, those unreasonable likings or aversions, irresistible longings and foolish fancies which, even in women naturally strong and well-minded, commonly accompany and are produced by pregnancy. Of a similar nature are the nervous excitability, waywardness of temper, physical and mental lassitude, and depression of spirits which have been generally noticed as constant attendants on the menstrual periods in many women. These are also of interest as demonstrating, despite any exceptional cases to the contrary, the futility of that hopeless contest with Nature's laws, in which those are now engaged who would have woman abandon her own high sphere, to become in every profession and in every avocation the rival, instead of the helpmate, of man.

Erotomania and nymphomania.—In connexion with this subject erotomania and nymphomania must be referred to. The former is but an undue exaltation of that sentimentality which to some extent is a natural characteristic of female youth, and which is fostered into morbid development by ill-directed education, and the prevailing sensuous tone of much of our popular literature. Highly coloured amatory word-pictures fill the minds of the young, unfit them for the duties of life, and give rise to those predominant illusions which morbidly occupy the thoughts of the erotomaniac, and may ultimately pass into the grosser pruriency of nymphomania. Whether originating in this way or not, nymphomania, when developed, is an entirely distinct disorder from the last-named complaint, and is generally connected with physical irritation or disease of some part of the sexual organs. Frequently it is associated with subacute endometritis or with oöphoritis, resulting in irritation and congestion of the erectile structure of the internal, as well as of the external, generative organs. In these cases pruritus of the vulva generally exists; and the local hyperæsthetic condition is followed by structural disease in the affected parts, hypertrophy of the nymphæ and clitoris, vaginismus, and chronic follicular vulvitis.

TREATMENT. — The moral, hygienic, and medical treatment of these conditions is discussed in other articles in this work. Here it is only necessary to add that in the treatment of no forms of disease is the exercise of the highest qualities of the physician more required than in the management of erotomania and nymphomania. In these cases he must act on the religious and moral as well as on the physical constitution of his patients; he must seek to turn the perverted current of thought into better channels; insist on healthy occupation of mind and body; and clearly point out the physical ill-health and mental debasement which surely await on sexual abuses. At the same time the judicious practitioner will endeavour to strengthen the physical powers by tonics; to diminish general plethora by saline purgatives, to remove local congestions by appropriate treatment; and to lessen nervous irritability by the bromides and other nerve-sedatives. Generally such patients are idle and over-fed, and require work and abstinence; and in addressing these persons their medical attendant may well re-echo the advice given to Falstaff by his quondam friend Prince Hal, and desire them to 'Purge, forswear sack, and live cleanly.'

With regard to local treatment in cases of nymphomania, all that need be said is that vaginal examinations, being likely to increase the irritability of the hyperæsthetic parts, should, as a general rule, be altogether avoided; or, at least, should be resorted to only in exceptional instances, and when absolutely indispensable. At the same time, however, it is obvious that where nymphomania is the result of local disease, neither moral nor general medical treatment can be of use until the topical exciting cause is removed. It may be admitted that, in certain exceptional cases and with suitable restrictions, clitoridectomy is a useful procedure.

Insanity.—The effect of sexual disorders on the mental functions can be only very briefly alluded to. The fact is certain that insanity in women is frequently connected with functional derangement or organic disease of some portion of the utero-genital organs. Indeed, in both sexes, although less obviously in men, reflex irritation from the sexual system has, probably, much to do with the causation of insanity. In the insane there is usually a peculiar insensibility to the ordinary symptoms of disease, resulting from the impaired nutrition and lowered vitality of the nervous centres and nerves of sensation. Therefore, in such cases, in the absence of the usual evidences of sexual disorders, the existence of these diseases is very likely to be overlooked. During the last few years several instances of mental derangement, of hysteria approximating to insanity, and of other forms of nervous disturbance arising from ovarian causes, have come within the writer's observation. In some of these cases the nervous disorder had existed for a considerable time before its local exciting cause was suspected. And, more than once, the writer has seen this ultimate recognition and treatment of obscure uterine or ovarian disease in a woman, who had been for years in a lunatic asylum, followed by the restoration of mental as well as physical health.

The ordinary occurrence of menstrual irregularities, and especially of amenorrhœa, in the early periods of insanity, is recognised by nearly all writers on this subject; and there seems a general concurrence of opinion as to the direct connexion between suppression of the menses and mental derangement in many instances. One of the most remarkable cases of this kind is that of a girl, mentioned by Pinel, who 'from the age of puberty was in a state of incoherence accompanied with suppression of the catamenia. One day on rising from bed she ran and embraced her mother, exclaiming, "Mamma! I am well." The catamenia had just flowed spontaneously, and her reason was immediately restored.'

Puerperal mania.—Puerperal mania is another instance of the influence of uterine or peri-uterine causes in disturbing the nervous system. The ætiology of this disease is very complicated, and it must be ascribed to the combined operation of several distinct factors. Foremost amongst these is the local congestion of the uterus during involution; and the shock and exhaustion consequent on parturition under conditions of mental depression, as shown by the fact that twelve out of twenty cases that came under the writer's notice occurred amongst unmarried patients in the Lying-in Hospital. Any circumstances that occasion suppression of the lochia or of the mammary secretion at this time, when the nervous system is in a state of peculiar tension, and the physical powers lowered, act directly as exciting causes of puerperal mania.

Alcoholism.—Uterine and ovarian disorders must also be reckoned amongst the predisposing causes of intemperance. The craving for alcohol in women of all classes may frequently be dated from the first painful menstrual period, when stimulants are often forced by foolish mothers into reluctant lips. The pain of dysmenorrhœa being thus relieved, at the next epoch the girl naturally, and no longer unwillingly, seeks similar solace, until, finally, the victim of dysmenorrhœal alcoholism may become a habitual, and perhaps an incurable, drunkard.

Cardiac disorder.—Of the cases of supposed heart-disease in nervous women which daily come before those connected with any large hospital, in a considerable number of instances the cardiac complaints are the result of hysteria, originating from chronic uterine or ovarian disorder, on the cure of which all the cardiac symptoms will subside. It is needless to dwell further here on the functional irregularities—palpitation, dyspnœa, and other symptoms of the same kind—which are thus connected with over-stimulation and irritation, or disease, of the female sexual system.

General health.—The consequences of premature or excessive indulgence and abuse of the sexual appetites on the general health claim merely a passing notice in this article. At no former time was it so necessary as at present for medical practitioners to recognise the evidences of these abuses and excesses; to which are due a large and increasing proportion of the disorders, mental and physical, by which human life is embittered or its duration shortened. The pathological results of these abuses, acting through and upon the nervous system, and the long train of maladies thus occasioned, must be familiar to every experienced physician.

THOMAS MORE MADDEN.

SEXUAL FUNCTIONS IN THE MALE, Disorders of.—The most important disturbances of the sexual functions in the male are described under the following headings, to which the reader is referred: IMPOTENCE; MASTURBATION; SPERMATORRHŒA; STERILITY IN THE MALE; and TESTES, Diseases of.

SEXUAL ORGANS, Diseases of. The diseases of the sexual organs in the male and female respectively will be found described under their special headings. *See* PENIS, Diseases of; TESTES, Diseases of; OVARIES, Diseases of; VAGINA, Diseases of; WOMB, Diseases of; &c.

SHAKING PALSY.—A synonym for paralysis agitans. *See* PARALYSIS AGITANS.

SHAMPOOING.—*See* MASSAGE.

SHANKLIN, in the Isle of Wight. Exposure E. Prevailing winds westerly. A bright, picturesque, tonic health-resort, with good sea-bathing. *See* CLIMATE, Treatment of Disease by; and SEA-AIR and SEA-BATHS.

SHINGLES (*cingulum*, a girdle).—A popular name for herpes zoster. *See* HERPES; and ZONA OR ZOSTER.

SHIVERING.—*See* RIGOR.

SHOCK.—SYNON.: Fr. *Choc*; Ger. *Shok*; *Wundstupor*; *Wundschreck*.

DEFINITION.—A condition of sudden depression of the whole of the functions of the body, due to powerful impressions upon the system by physical injury or mental emotion.

Its more obvious manifestations are signs of lowered activity of the cardiac, respiratory, and sensorial functions; and reduction of the surface temperature.

General Description.—If a person be unexpectedly subjected to the influence of extreme terror, if a large bone or joint be shattered, or an important viscus injured, the entire system receives a profound impression, and its functional activity is more or less stunned. The whole body appears to sympathise with the injury inflicted on one of its parts; the patient is prostrated by an indescribable sense of bodily anguish and oppression; he feels sick and faint; is seized with tremor; totters or falls; the surface becomes pale, cold, and covered with sweat; the expression of countenance is vacant, yet anxious; and the respiration and circulation are weak and irregular.

Shock varies in degree, from the most trifling amount, which rapidly disappears, to that producing instantaneous death, as in the case of lightning stroke, or of a severe blow on the epigastrium.

The intensity of shock depends on the nature and extent of the injury producing it; on the co-existence of internal or external hæmorrhage; and also upon the age, habits, temperament, and idiosyncrasy of the individual, and his mental condition at the time of the injury. Direct violence applied to the brain or spinal cord produces shock in the most intense form; but in such cases, which are beyond the scope of this article, the symptoms due to the local lesion predominate, and are, of course, the more important.

Shock is usually immediate in its effects, but sometimes these may be for a time deferred by intense mental preoccupation or excitement. 'Nature,' as Hunter said, 'does not feel the injury.' The soldier during the excitement of battle may be unconscious for a time of the severity of his wound, but presently he is recalled to a sense of danger, and the depression which ensues will be increased in proportion to the previous excitement.

Ætiology.—Intense mental impressions, such as extreme terror or apprehension of death or mutilation, are capable of producing shock in persons of excitable nervous temperament. Some individuals are so readily affected that a certain degree of shock may be induced by the most trifling lesion, or even by the sight of an injury inflicted upon another.

It may be stated generally, however, that whatever is calculated to produce psychical depression will aggravate the shock induced by other causes. Wounds, for instance, inflicted on the soldiers of a beaten army, or on those in a closely besieged town, are often followed by greater shock than are wounds of a similar severity occurring under more favourable circumstances.

Injury is the chief cause of shock. As a rule the more extensive the injury, the nearer it is to the centre, and the more it assumes a crushing character, the greater will prove the amount of shock. The crushing of a finger or bruising of a testicle often occasions severe shock; so also do extensive burns and scalds. Intense pain, without serious organic lesion, is capable of producing shock, as may be witnessed during the passage of a gall-stone through the duct, or of a calculus through the ureter.

Loss of blood associated with the injury greatly augments the degree of shock; and it may be impossible to separate the symptoms due to the more direct physical impression from those caused by the hæmorrhage. Shock is, however, independent of the presence both of pain and of hæmorrhage. During the operation of castration a patient, while under the influence of chloroform, and in the absence of hæmorrhage, may sometimes present symptoms of severe shock the moment the cord is divided. After disarticulation at the hip or shoulder joints, and in other great operations, the patient may present features of shock altogether independently of either pain or loss of blood.

The frequency of shock after operation has diminished since the introduction of anæsthesia, but the prolonged administration of chloroform may itself occasion some of the symptoms; and it is by no means unlikely that fatal accidents during chloroform-administration may be due to the combined depressing influences of the shock and the anæsthetic.

Injuries extensively involving the bones and joints are prone to induce shock. The temperature has been observed in some instances to fall during the sawing of the bone in amputation.

Railway accidents, happening as they do very suddenly, and occasioning great alarm; acute peritonitis caused by the escape of irritating substances into the abdominal cavity, as in perforation in typhoid fever; the strangulation of a hernia; or a sudden and severe intussusception, may each and all be attended by symptoms of shock in a more or less intense degree.

Pathology.—It is still difficult to explain the *modus operandi* by which any kind of physical injury, of sufficient severity, implicating a portion of the body, may produce the set of phenomena known as shock. The story told by the symptoms is one of depression of all the vital functions, associated with the evidence of a diminished circulation of blood in those portions of the periphery which we can examine during life. The integument is blanched and shrunken; the pulse is thready or imperceptible; the veins are collapsed; and open wounds, unless involving large arterial trunks, bleed slightly, or cease to bleed; while the lowered temperature, as registered in the axilla and mouth, marks a coincident diminution of tissue-metamorphosis. That the brain suffers from a similar privation of blood is indicated by the enfeebled pulsation of the carotid arteries; by the anæmic condition of the retinal vessels, as shown by the ophthalmoscope; and by the mental torpor and diminished irritability, conjoined or separate, which constitute invariable features of the condition. How far these changes are shared in by internal organs it is at present impossible to say; but, awaiting further investigations, the facts already known are sufficiently definite and constant to guide us in the direction of a rational pathology.

The manifestations of inadequate blood-supply to the tissues in general are almost identical with those of hæmorrhagic asthenia; but no hæmorrhage may have taken place, and we must seek the blood which has left the anæmic parts in some other vascular territories.

If we make a *post-mortem* examination in a case where death has forestalled nature's effort at reaction, one striking phenomenon is revealed, namely, an enormous distension of the abdominal vessels governed by the splanchnic nerves. Into this capacious set of vessels has been diverted a great mass of the blood destined for other regions; and being thus practically withdrawn from the general circulation, it has produced a useless congestion of the abdominal viscera, at the expense of the nutrition of the rest of the system, while the weakened heart contracts feebly but hastily upon the scanty supply which now passes through its cavities.

Physiologists have taught us the probable cause of this. Long since it was demonstrated that stimulation of the central end of the divided depressor branch of the vagus, in the rabbit, produces an immediate lowering of the blood-pressure in the arteries of the head, neck, and extremities; this effect coinciding with, and depending upon, a dilatation of the abdominal arteries, and a consequent deviation of the blood-flow in the direction of least resistance, or towards the abdominal viscera. If, however, the splanchnic nerves be cut, the reflex circuit is broken and the balance of the circulation becomes restored, or nearly so, although the irritation of the depressor nerve be continued. The experiment of Goltz, of directly paralysing the splanchnic of a frog by sharply striking the abdomen, was followed by the same result as is the reflex paralysis of the same branches through the depressor nerve; and it is likely that the severe shock caused in man by a severe blow on the epigastrium owes its origin to a similarly induced paralytic dilatation of the visceral arteries. Thus for the present we may accept, as the most plausible interpretation of the symptoms of shock, a sudden dilatation of the abdominal vessels, attributable to the loss of inhibitory influence exerted upon the splanchnics, through the medium of a special reflex centre, which is in more or less direct communication with the sensorium, and with all parts of the body. It has been shown that when a rabbit is narcotised by chloral hydrate, stimulation of the central end of the divided sciatic nerve will induce a lowering of arterial pressure, corresponding closely to that initiated by stimulation of the depressor branch; and in all probability a similar experiment upon any nerve containing afferent fibres would be followed by the same result. But if, on the other hand, the same stimulation be performed while the animal is paralysed by curare, it is remarkable that the effect is reversed, the vessels controlled by the splanchnics contracting, and the general arterial tension being consequently increased. These observations are in the highest degree suggestive, and may hereafter form the basis for a plan of treatment of shock that will be a landmark in surgical therapeutics.

Symptoms.—The symptoms of shock are of two kinds—namely, first, those due to a stunning or blunting of the vital powers, aptly styled *Wundstupor* by the Germans; and, secondly, those attributable to mental terror, anxiety, and agitation—*Wundschreck.* These may exist together, or separately, or one may pass into the other.

1. *Pure* or *torpid shock*, as distinguished from the latter form, which may be termed 'erethistic shock,' is manifested, if only slight in degree, by transient symptoms. The patient becomes pale and faint; complains of nausea; trembles; and experiences a sense of oppression, confusion, and anxiety; the surface becomes cold and moist; beads of sweat form on the brow; and the limbs may be unable to support the weight of the body. The duration depends much on constitutional peculiarity; the symptoms either passing off in a few minutes, or lasting for an hour or two. If the shock be severe, the patient immediately after the receipt of the injury is stunned; his senses and consciousness are benumbed; the countenance and the surface generally become deadly pale, and are bathed with sweat; the animation of the face is replaced by a mingled expression of torpor and anxiety; from time to time muscular contractions and uneasy movements of the body may occur, but usually there is an absence of voluntary effort; the eyes are dull, vacant, and motionless, and the pupils are generally dilated; the temperature—an important index to the severity of the shock—ranges from one to two degrees or more below the normal, and is still lower when there has been extensive loss of blood; the respiration is remarkably slow and irregular—faint, scarcely perceptible, inspirations alternating with deep sighs; and the pulse may be almost or quite imperceptible at the wrist, very weak, insufficient, and very rapid. The patient is con-

scious, but he sees and acts as through a haze, and cannot realise his position; urgently questioned, he replies slowly and with evident effort; his voice is weak and hoarse; he may complain of coldness and numbness of his limbs, but appears scarcely sensible of pain. There may be nausea, and even vomiting; and relaxation of the sphincters, with involuntary discharge of fæces, is occasionally observed.

The fall of temperature in shock, excluding cases of injury to the brain and spinal cord—where it is greatest of all—is proportionately greater, other things being alike, in injuries extensively involving bones and joints, in burns and scalds, and in the cases where there has been considerable loss of blood. It is greater in amount in men of forty than in those of twenty. During the War of the Commune a number of observations were taken, and the average temperature varied from 96·5° to 97·5° F., the lowest temperature observed being 93·5° F. The fall was greater after shell- than bullet-wounds; and amongst the insurgents than in the regular troops.

2. In the *shock with excitement—restless* or *erethistic shock*—symptoms of anxiety and restlessness predominate. This form is often witnessed in association with previous hæmorrhage; or when there is great pain, as in crushing injuries of important parts, and in burns or scalds. Individual idiosyncrasy, however, has an important influence upon the condition. The ordinary symptoms of shock, such as pallor, cold surface, frequent pulse, and feeble respiration, are present. The patient in addition betrays a marked and unceasing restlessness, tossing about in bed, and throwing his arms and head from side to side; his consciousness is but little impaired, yet he pays no heed to questions; nothing seems to comfort or quiet him; he appears as if overwhelmed by some indescribable anxiety and oppression, of which he vainly struggles to rid himself. Vomiting and painful eructations are usually present in such cases. There is often considerable tremor, and sometimes the case will pass into well-marked delirium tremens. The torpid may pass into the erethistic form of shock; or shock with excitement may lapse into a torpid condition, which is always a change of bad omen.

Duration.—Shock, unless it be the result of serious or fatal injury, is generally recovered from speedily and completely. It may be quite gone in fifteen minutes or half an hour; or it may continue five or six hours, or longer, and then pass away. The erethistic or restless form of shock does not continue so long as the torpid. The less important the vital lesion; the less it has been complicated with loss of blood; the greater the power of the individual; the less his nervous susceptibility; and, finally, the more efficient the treatment, the shorter will prove the duration of the shock.

Terminations.—Recovery or reaction takes place readily from the milder forms of shock, especially when aided by suitable treatment. From the more severe, it is more difficult and protracted; or the case may end more or less rapidly in fatal collapse. When the reaction proceeds favourably, the pulse becomes stronger and fuller, the respiration deeper, and the bodily warmth returns. The mind appears to awaken to the exercise of its faculties, to shake off its oppression, and to appreciate the nature of the previous injury, and of the existing circumstances; and both the mental and physical equilibrium are by degrees restored. Vomiting is often an early symptom of recovery.

After severe shock symptoms of excessive reaction are not uncommon; and their gravity will vary with the intensity of the previous shock.

The reaction is not always steady. Fluctuations may occur; and relapses after an improvement often occur once or twice, each time, however, with diminished severity. In other cases the symptoms of shock will endure for a much longer period, may increase in intensity, and terminate fatally.

When the torpid form of shock passes into the erethistic, the condition becomes one termed 'prostration with excitement'; the respiration is hurried, the skin hot, and the face flushed. There are great thirst, headache, and scanty urine, with restlessness, tremor, incoherence or delirium, and sleeplessness; and death from exhaustion frequently follows, preceded by a haggard, wild expression of face, a pulse that cannot be counted, subsultus, and hiccough.

Complications and Sequelæ.—The complications which may arise are those due chiefly to loss of blood, or peculiar to the form of injury received. From ordinary uncomplicated shock recovery is usually perfect, but occasionally, especially after railway shock, permanent deterioration of health follows, or some impairment of a special sense; or the mental vigour or temper of the individual may be changed for the worse. In these cases organic changes in the nerve-centres have probably supervened. In drunkards the shock of injury very often terminates in an attack of delirium tremens.

Pre-existing organic disease, especially of the heart or kidneys, renders persons more susceptible of the effects of shock, which is then more severe and dangerous.

Diagnosis.—The phenomena of shock bear some resemblance to those of concussion and of syncope. Concussion is usually distinguished from shock by the predominance of intellectual disturbance over the circulatory symptoms; and syncope is in most cases marked by its more transitory duration, and by its origin in loss of blood, or in other well-known causes of the condition. Shock, however, may co-exist with either concussion or syncope.

PROGNOSIS.—This mainly depends on the nature of the injury, and the physical and mental power of the individual. Otherwise, the longer the shock endures, the feebler the manifestations of life, and more especially the lower the temperature falls, the more unfavourable becomes the prognosis. A fall of temperature below 96° nearly always presages a fatal issue. It is a very unfavourable sign when no rise of temperature takes place in four or eight hours after the receipt of injury. Extreme feebleness of pulse and respiration, marked tremor, profuse cold sweats, singultus, a feeling of impending dissolution, and involuntary evacuations, all indicate the gravity of the case.

TREATMENT.—The objects of treatment in shock are to sustain the lessened vitality, but not to over-stimulate it; and to moderate subsequent reaction when it is excessive.

To apply external warmth is the first and plainest indication, as it is one of the most potent appeals to the misdirected circulation. Hot-water bottles and hot blankets may be applied to the extremities; hot turpentine epithems and sinapisms to the præcordia; and turpentine may be rubbed along the spine with advantage. If the patient cannot swallow, an alcoholic stimulant may be injected into the rectum; and ammonia may be inhaled, or ether subcutaneously injected. Slapping the hands and feet promotes recovery in some cases, but this measure is improper and inefficacious in cases of severe injury, or those accompanied by great loss of blood.

In profound shock, unaccompanied by loss of blood, the breathing must be carefully watched, and failure guarded against by artificial respiration. The phrenic nerve may be usefully stimulated by electrodes placed along its course in the neck and over the epigastrium. If the external jugular vein be gorged with blood, it may prove advantageous to open it, and thus relieve the stagnation of the venous circulation. Where shock has been accompanied by severe hæmorrhage, transfusion of blood, serum, or normal saline solution in extreme cases should be resorted to (*see* TRANSFUSION OF BLOOD). As soon as practicable, nourishment must be administered, as well as stimulants. Tincture of belladonna has been given in half-drachm doses every hour in some cases, with the view of stimulating the cardiac action, and helping to contract the paralysed arterioles. The use of Calabar bean has been recommended, on account of its alleged power to diminish the venous accumulation in the abdomen, by causing contraction of the veins.

If shock be associated with excitement, which should be regarded as a sign of want of power, the patient always requires support; and opium, or, when this drug is not admissible, henbane or chloral hydrate may often be given with advantage. An ice-coil to the head allays excitement and promotes sleep. In the torpid form of shock narcotics are inadmissible. Should inflammatory reaction take place, a regulated diet, rest to mind and body, a gentle mercurial purge, when the secretions are deranged, and in young plethoric subjects the cautious administration of antimony, or a local blood-letting, are the chief means to be adopted. Throughout the treatment caution should always be exercised not to strain the action of remedies too far.

The question of operation in shock may occasionally be difficult to solve. As a rule, a patient suffering from severe shock should never be operated upon; unless, indeed, bleeding be going on, or the arteries and nerves are much exposed and lacerated from the violence of the injury. When an operation appears to be compulsory no anæsthetic is required. It is better, however, to await partial reaction whenever it is possible to do so; but in some cases operation, by relieving the patient of the pain and distress caused by, for instance, a crushed limb, will at once procure an abatement of the condition of shock. WILLIAM MAC CORMAC.

SHORTNESS OF BREATH.—*See* RESPIRATION, Disorders of.

SHORT-SIGHTEDNESS. — *See* MYOPIA; and VISION, Disorders of.

SIALAGOGUES (*σίαλον*, saliva; and *ἄγω*, I move).—SYNON.: Fr. *Sialagogues*; Ger. *Speicheltreibende Mittel.*

DEFINITION.—Remedies which increase the secretion of saliva.

ENUMERATION.—The principal sialagogues are Dilute Acids, Ether, Ginger, Rhubarb, Horseradish, Iodide of Potassium and other iodides, Jaborandi, Mezereon, Mercury and its salts, Mustard, Tobacco, Physostigmine, Pyrethrum, and Pebbles.

ACTION.—There are two essential factors in the secretion of saliva: the first is the activity of the secreting cells in the gland; the second is a sufficient supply of nutritive material to them, from which they may form a secretion. This nutritive material, though it may be derived directly from the lymph-spaces around the cells, must be ultimately supplied by the blood circulating through the glands. Usually, therefore, when the gland is in action, the supply of blood is greatly increased, the arteries dilating, and the blood flowing rapidly through them. Some drugs, such as physostigmine, will stimulate the secreting cells, while they contract the blood-vessels; under these circumstances, although the secretion may begin actively, it soon comes to a standstill from want of material. The secreting cells may be excited to activity by substances which stimulate the nervous structures within the gland itself, as, for example, Calabar bean (physostigmine); by stimuli proceeding directly from the encephalon, as seen in salivation occurring from the mere idea of savoury food; and by stimuli applied to the mouth and exciting the gland reflexly. Nausea is almost always accompanied by salivation, and substances which cause nausea almost invariably cause salivation, the irritation of the stomach causing reflex salivary secretion. The stimulus here passes up the afferent nerves to the medulla, and travels down the efferent nerve to the gland.

Sialagogues are divided, according to their mode of action, into two classes—(1) *topical* or *direct*; and (2) *specific*, *remote*, or *indirect* sialagogues. The names *direct* and *indirect* are complete misnomers, just as they are in the case of emetics, and they ought to be discarded, inasmuch as the so-called 'direct' sialagogues are those which do *not* act directly on the gland, but on the mouth; and the 'indirect' are those which do act upon the gland, affecting either the nervous structure contained within it, or the nerve-centres directly connected with it.

The *topical* sialagogues are dilute acids, ether, ginger, rhubarb, horseradish, mezereon, mustard, pebbles, pyrethrum, and tobacco. The *remote* sialagogues are iodide of potassium and other iodides, jaborandi, mercury and its salts, physostigmine, and tobacco.

Topical sialagogues excite secretion of saliva reflexly, the afferent nerves being the lingual and buccal branches of the fifth, and the glosso-pharyngeal nerves. The afferent nerves, through which nauseants probably excite the salivary secretion, are the vagi.

Of remote sialagogues, iodide of potassium probably acts upon the gland-structures, but upon which part has not yet been determined. It may, however, also act reflexly, by stimulating the sensory nerves of the mouth, as it is excreted in the saliva, and the taste of it is often persistent. Mercury probably acts partly by affecting the gland-structures, and partly by affecting the mouth. Jaborandi, physostigmine, and tobacco appear to affect the terminal branches of the secretory nerves in the glands.

Uses.—Saliva is useful in keeping the mouth moist, and thus facilitating mastication, deglutition, and the movements of the tongue in speaking. By moistening the fauces it also prevents or lessens thirst. A pebble placed under the tongue, or masticated, will keep up a slight flow of saliva, and may be useful for these purposes. Where this is insufficient, dilute acids are employed (*see* Acids). As the flow of blood to the glands is greatly increased during secretion, sialagogues, and especially pyrethrum, have been used as derivatives, to lessen inflammation, congestion, and pain in other parts of the head, as in toothache, earache, and inflammation of the ear, nose, or scalp. Saliva has also, however, a digestive power upon starch, and increase of the flow may be advantageous in imperfect digestion of this substance. When swallowed, the saliva stimulates the secretion of gastric juice, and increased salivary secretion therefore tends to aid gastric digestion. To attain this object it is best to chew a piece of ginger or of rhubarb.

T. Lauder Brunton.

SIBBENS.—This term, derived from a Scotch word signifying 'kindred' (cf. German *Sippschaft*), is suggestive of a disease prevalent in families, and presumed to be a form of syphilis.

SIBILANT RÂLE or RHONCHUS: SIBILUS (*sibilus*, whistling).—A variety of dry *râle* or rhonchus, of a whistling or high-pitched musical character, usually produced in the smaller divisions of the bronchi. *See* Physical Examination; and Rhonchus.

SICILY.—A warm, moist, winter climate. Climate of base of Etna more variable than of N. coast. *See* Climate, Treatment of Disease by; and Palermo.

SICK-HEADACHE.—A popular synonym for megrim. *See* Megrim.

SICKNESS.—A common synonym for vomiting. *See* Vomiting.

SIGHT, Disorders of.—*See* Vision, Disorders of.

SIGNS OF DISEASE.—*See* Disease, Symptoms and Signs of; and Physical Examination.

SIMPLE IDIOPATHIC MUSCULAR ATROPHY. — *See* Progressive Muscular Dystrophy.

SINGULTUS (Lat. sobbing, hiccough). A synonym for hiccough. *See* Hiccough.

SINUS (Lat.). — Pathologically, sinus means a narrow track of variable length, leading from a chronic abscess to a free surface. *See* Abscess.

SINUSES, CEREBRAL, Diseases of.—*See* Meninges, Diseases of.

SINUSES, NASAL, Diseases of.—*See* Nose, Diseases of.

SIXTH NERVE, Diseases of.—The sixth nerve, or *abducens oculi*, confers motor power on the external rectus muscle of the eyeball, and its morbid states of excessive or defective function are indicated by corresponding spasm or paralysis of that muscle.

1. Spasm of the external rectus.—This condition is very rare, except as a consequence of some change in the visual functions of the eye. The external rectus may then habitually overact. Permanent contraction occurs when there is complete paralysis of its antagonist, the internal rectus. Spasm may occur from irritation of the nucleus or fibres of the sixth nerve, as in meningitis of the base. The symptoms are inclination outwards of the affected eye, and consequent divergent strabismus. The treatment is that of the cause on which it depends. *See* Strabismus.

2. **Paralysis of the external rectus.** Ætiology. — Among common causes are tumours, and other lesions within the pons, and various forms of syphilitic disease. The latter may cause a specific growth on the nerve, or damage it by inflammation and compression by the new tissue which is so abundantly formed in syphilitic meningitis. It suffers also in other forms of meningitis with great readiness, on account of its long course, which renders it liable to be involved in various regions of the base, and to be affected more frequently than any other cranial nerve. Its exposed course also causes it to suffer with readiness from distant pressure, and it often first reveals a general increase in pressure beneath the tentorium. Hence tumours of the base of every kind are frequent causes of its paralysis. From disease in the anterior part of the base, at the orbital fissure, and within the orbit, the nerves to other ocular muscles are usually also involved. Isolated neuritis, due to cold, is a rare cause. Transient or permanent paralysis of the sixth nerve sometimes accompanies sclerosis of the posterior columns of the spinal cord (locomotor ataxy); its cause is obscure.

Symptoms.—Paralysis of the external rectus causes inability to move the affected eye outwards, and hence convergent strabismus, and homonymous diplopia when looking at an object on the affected (*e.g.* left) side of the middle line, the images becoming more distant as the object is moved to the left; but parallel, and on the same level, so long as it is on the horizontal plane. When looking up or down as well as out, the second image slants, the two being nearer together at the lower end, and the second image the lower of the two when looking up and out. On looking down and out, the two images are nearer together at the top than at the bottom, and the second image is on a higher level than the other. There is erroneous projection of the field of vision, and a tendency to giddiness when the affected muscle is used.

Diagnosis.—Paralysis of the sixth nerve is easily recognised, except when slight in degree. In the latter case it may often be detected by a careful search for the diplopia, or by the secondary deviation of the sound eye in the same direction when that eye is covered and an object fixed by means of the weak muscle. *See* Strabismus.

Prognosis.—The prognosis is most favourable when the paralysis is due to cold or syphilis; least favourable when due to meningitis or tumour. When associated with ataxy, it is usually recovered from, but a return is common, and a recurrence frequently does not entirely pass away.

Treatment.—When the complaint is of rheumatic origin, the treatment should consist of hot fomentations to the temple; counter-irritation by blisters; and iodide of potassium and tonics internally. If of syphilitic origin, iodine or mercury should of course be given.

In spinal mischief, strychnine and arsenic may be employed. In obstinate cases the use of faradisation, or the slowly interrupted voltaic current, has been recommended, applied to the muscle through the eyelid, or to the temple to produce a reflex effect. The direct application to the muscle through the conjunctiva is too painful. The value of any electrical application is, however, extremely doubtful.

W. R. Gowers.

SKIN, Discoloured.—*See* Pigmentary Diseases of the Skin.

SKIN DISEASES.—Synon.: Fr. *Maladies de la Peau*; Ger. *Hautkrankheiten.*—Introductory.—It is necessary in the first place to explain clearly what is included in the expression 'diseases of the skin.' The skin itself is a complicated structure containing a large number of glands, and made up in the main of fibro-vascular and nervous tissues. Its structure being similar to that of many other parts of the body, we should expect to find it liable to similar diseases, and this is in fact the case. We meet with, for example, the various pathological changes common in other organs, such as morbid growths, hypertrophy, atrophy, and hæmorrhage; it is also liable to congestion and inflammation, similar to if not identical with those found in the mucous membranes; and its glands are equally liable with other glandular organs to functional derangements. This being the case, it must be always borne in mind that skin diseases, although they present to the naked eye appearances quite peculiar and unlike anything that we are in the habit of seeing in other parts of the body, yet are due to exactly the same pathological processes that we are familiar with elsewhere.

Most writers on diseases of the skin have included under this head not only diseases proper, but also what we may call symptomatic rashes, such, for example, as the eruptions of contagious fevers, and the rashes produced by drugs. They have, in addition, included some general diseases in which the changes in the skin form a striking or prominent feature, such, for instance, as leprosy and syphilis. With regard to the class of exanthematous eruptions, it may be said that they are not now usually classed among skin diseases, although it must be admitted that such affections as small-pox and chicken-pox are quite as much diseases of the skin as many others that are still retained in that category. The fact that the eruptions of the exanthemata are really symptomatic of certain general maladies has tended to foster the belief that skin diseases are also only symptomatic of changes going on in other parts of the body; this, however, is by no means always or even generally the case. A similar erroneous view, that skin diseases are only eruptions, has been much favoured by the nomenclature and classification of Willan, which has had an enormous influence on all subsequent writers nearly up to the present time; so that even at this day it is not very uncommon to hear a medical man of the old school speak of a patient as suffering, for example, from eczema, lichen, and psoriasis at one and the same time on different parts of the body, according as the eruption is vesicular, papular, or scaly.

Nomenclature.—At the present time, when there is a free interchange of views between different members of the profession both at home and abroad, a uniform nomenclature for skin diseases is highly desirable. A very close approximation to this has already been attained in all the principal countries of Europe and America. This result has been gradually brought about, not by any sudden change, but by a steady exclusion of those names that are useless or obsolete, and the retention of those only that have a definite meaning or indicate definite diseases. Most of these names have become familiar by long use, but have now assigned to them a more exact and scientific value than formerly.

In addition to the exclusion of superfluous names and the more accurate application of others in use, a further change has been made by the introduction of a small number of new names. Some of these merely replace old ones, as, for example, 'xanthelasma' replaces 'vitiligoidea'; in other cases, old but suitable names have been substituted for inconvenient ones, as 'lepra' for 'elephantiasis Græcorum'; and, lastly, a very few newly discovered diseases have required new names. It should always be remembered that, *cæteris paribus*, *single* are preferable to double names. The latter, however, cannot be entirely avoided; but in this respect we are slowly moving in the right direction—for instance, the names 'lepra,' 'zona,' and 'area' are preferable to their synonyms, 'elephantiasis Græcorum,' 'herpes zoster,' and 'alopecia areata'; indeed, everything that tends to simplify names is an advantage. The *Nomenclature* published by the Royal College of Physicians is the one now in general use, and leaves little room for improvement.

To those who have not made a special study of skin diseases, the nomenclature, in spite of all improvements, is still puzzling. This is easily explained: it arises from the fact that a large number of synonyms have gradually accumulated in past times. Each writer who thought he had discovered a new disease gave it a name; sooner or later it was found to be no new disease at all, but the error lasted long enough to add another synonym—for example, there are at least six synonyms for tinea tonsurans, all more or less in use; and so with other common skin diseases.

Up to this point all writers are agreed. There are, however, the following eruptions with regard to the nomenclature of which some difference of opinion exists: (1) mixed or hybrid skin diseases; (2) syphilitic skin diseases; (3) medicinal rashes.

1. *Mixed* or *hybrid skin diseases.*—It is rather unusual to see two definite diseases of the skin occurring at the same time in one and the same person; it does, however, sometimes occur. It is obvious, for instance, that scabies and ringworm may be met with in those who are liable to eczema or psoriasis, or that acne may be present in a person suffering from lupus. When two skin diseases are present at the same time, they generally remain quite distinct, so that it may be stated definitely that hybrid skin diseases rarely, if ever, exist; and therefore hybrid names, such as 'lupus-psoriasis,' should be avoided.

2. *Syphilitic eruptions.*—It was formerly the custom to apply to syphilitic eruptions the names of those ordinary diseases of the skin which they most closely resemble, preceded by the name 'syphilitic.' Thus we have syphilitic psoriasis, syphilitic lupus, and even syphilitic varicella. These names have not been used to indicate any mixture of two diseases, but simply as a convenient form of nomenclature. Syphilitic psoriasis would, of course, mean not a hybrid disease, but a syphilitic eruption resembling psoriasis. It is admitted that the nomenclature is convenient, but it is nevertheless erroneous, and it is especially misleading to beginners. Take, for example, one common misnomer—syphilitic lupus; what can be more puzzling to a student who has studied the pathology of lupus than to hear his teacher speak of *syphilitic* lupus? Although we may lose some descriptive force in speaking and writing, yet on the whole it is better to use such terms as macular, papular, vesicular, squamous, pustular, and ulcerating syphiloderma, than to retain the old erroneous nomenclature. And when we consider how very polymorphic syphilitic eruptions are, we soon perceive that the modern nomenclature has its advantages; it is always awkward, for example, to speak of a patient as suffering from syphilitic psoriasis in one part of the body and syphilitic lupus in

another, whereas we can more easily and correctly speak of squamous and ulcerating dermato-syphilis.

3. *Medicinal rashes.*—Cutaneous eruptions are occasionally produced by the administration of drugs, and the nomenclature often applied to these rashes is similar to that formerly applied to syphilitic eruptions, and is open to the same objections. In these cases it is better to name the eruption from the drug which has produced it; for example, whatever the form of the eruption produced by bromide of potassium, it is best to call it simply a bromide of potassium rash.

We may briefly sum up our conclusions thus:—

(1) It is very doubtful whether hybrid skin diseases exist at all; and certainly there is no justification for a hybrid nomenclature.

(2) Syphilitic eruptions differ from ordinary skin diseases in their ætiology, pathology, and treatment; and that this difference should be fully recognised in our nomenclature.

(3) Medicinal rashes are not diseases of the skin, but simply eruptions, and should be so named.

Classification.—Dermatologists have always found a fascination in attempts to classify diseases of the skin; it must be admitted, however, that the results of such attempts, though interesting, have been of little practical value.

In natural sciences—such, for example, as botany and zoology—the value of classification is evident enough; but when you have to deal with so small a number as seventy or eighty diseases at most—which, moreover, are not natural and therefore do not admit of a natural classification—the difficulty and practical inutility of the result become obvious. The past history of classification is both interesting and instructive.

About the year 1780 Plenck, a professor at the University of Buda-Pesth, published a classification of skin diseases, which has practically held its ground till recent times. Plenck's classification was based chiefly on the anatomical characters of the eruption or elementary lesions, and he divided skin diseases into the following fourteen classes: (1) Maculæ; (2) Pustulæ; (3) Vesiculæ; (4) Bullæ; (5) Papulæ; (6) Crustæ; (7) Squamæ; (8) Callositates; (9) Excrescentiæ; (10) Ulcera; (11) Vulnera; (12) Insecta cutanea; (13) Morbi unguium; (14) Morbi capillorum. This method of grouping was a very good one for the time in which it was published. Willan followed Plenck very closely, and his eight orders correspond to eight of Plenck's. He, however, wisely omitted the order Crustæ, and introduced the order Exanthemata, a doubtful gain. Willan's classification was based entirely on the elementary lesions, and in this respect was more logical, though less comprehensive, than Plenck's. Hebra has in his system of classification reintroduced Plenck's orders 10 and 12.

Alibert tried to classify skin diseases according to their natural relationship, but his attempt was a signal failure. In the year 1844 Hebra introduced his system of classification, based chiefly on morbid anatomy, and up to the present time it has been almost universally adopted as a basis of classification which, on the whole, presents fewest objections. Hebra divides skin diseases into the following twelve classes:—

(1) Hyperæmic affections of the skin; (2) Anæmic affections of the skin; (3) Morbid conditions of the secretions of the cutaneous glands; (4) Exudations; (5) Hæmorrhages; (6) Hypertrophies; (7) Atrophies; (8) Innocent growths; (9) Malignant growths; (10) Ulcers; (11) Neuroses; (12) Parasites. Of these he remarks: 'For the denomination of the first eleven classes or families I have employed the name of a pathological process—that is to say, of a thing which, being only a conception of the mind and invisible, can be recognised only by its effects. On the other hand, the name of the twelfth class is derived from the cause of the diseases which belong to it, which cause is positive and has a real existence. But, although I must thus admit the logical defect in the principle of classification which I have adopted, yet I have not been able to remedy it without risking the practical usefulness of the system.' He further remarks: 'The separation of the eighth from the ninth class may be termed arbitrary and even incorrect from the histological point of view. Again, in accordance with precedent, it was not necessary to have introduced ulcers into dermatology, at least not as a distinct class.'

A study of the correlation of skin diseases is always interesting and useful, but when any attempt is made to reduce their relationships to an exact system of classification, the difficulties of the task become apparent; and time does not tend to remove them, for as our knowledge becomes more exact and extensive, the more clearly do the difficulties appear.

Diagnosis.—The diagnosis of skin diseases is often attended with difficulty. This arises from the fact that their development is liable to great irregularity, so that no two cases, even of the same disease, are exactly alike. Nothing is easier than the diagnosis of typical cases, such, for example, as we should choose for the purpose of illustration; unfortunately a considerable number are abortive, and present an appearance quite different from what we are in the habit of regarding as the usual type. These remarks apply not so much to rare diseases as to many of the common forms; but, in addition to this, we meet from time to time with altogether anomalous cases which do not correspond with any of those described in our text-books. These latter, however, are extremely rare, and do not form any serious impediment to ordinary diagnosis.

In order to make a successful diagnosis of diseases of the skin, the following points are worthy of especial attention:—

1. A rule of great importance is to examine as far as is possible the different parts of the body on which the eruption is present. The necessity of this arises from the fact that a disease may exhibit a very different appearance in one region from what it does in another; it may, for example, be abortive in one part and typical in another. Syphiloderma supply us with many examples which illustrate this point. Some portions of the eruption may be highly characteristic, while others would hardly serve as a means of diagnosis.

2. In conducting an examination, our object is in the first instance to take a broad view of the eruption as a whole, irrespective of the particular elementary lesions. We do this almost instinctively, and comprehend at a glance the importance of combination and arrangement, and that this or that elementary lesion, taken singly, does not constitute the skin disease; thus, when we speak of a vesicular, papular, pustular, or squamous disease, we convey but a very imperfect idea of its nature. The parts of the body affected, the tissues involved, the form, arrangement, and grouping of the eruption, the degree of inflammation, and many other points, are often of as much importance as the minute anatomical details.

3. In any given case under observation we should always distinguish what is essential from what is non-essential or accidental; what belongs to the original affection from what has been superadded; and we should select for special examination those portions of the skin in which the disease is least complicated; for example, in order to demonstrate the presence of the itch acarus, we do not choose a part of the body that is thickly covered with crusts, but we endeavour to find it in a patch of soft skin nearly free from secondary inflammation. Endless examples might be given of the changed appearance that skin diseases present from being complicated with cutaneous hæmorrhages or urticaria, or with the excoriations produced by scratching or even by treatment.

4. The distribution of the eruption is often a valuable aid to diagnosis. As a rule, when eruptions appear symmetrically on various parts of the body, we have to deal with a more or less constitutional malady, or one due to a specific poison pervading the system. Psoriasis and prurigo would furnish examples of the former, and the exanthemata and secondary syphilis of the latter class of cases. Some diseases, on the other hand, are invariably confined to certain parts, as gutta rosea and sycosis. Other affections, though not so strictly localised, yet have a marked preference, to use a common expression, for certain regions; for instance, erythema nodosum is commonly confined to the legs, acne to the face and shoulders, tinea versicolor to the trunk, lupus erythematosus to the face and ears, area to the scalp and hairy parts of the face; and to these examples many more might be added.

5. Hitherto those phenomena in skin affections which are appreciable to our senses of sight and touch have alone been referred to, namely, the general character of the eruption, the tissues involved, and the parts affected. There are, however, other means of diagnosis, less perfect in their nature, and less under our immediate cognisance—the subjective sensations of the patient. The more important of these are itching, burning, or tingling and neuralgic pains; they are, however, of minor diagnostic value.

6. The history of the case may sometimes be valuable as an aid to diagnosis; its value is, however, generally over-estimated. It is quite common, for instance, to lay too much stress on a previous history of syphilis; on the other hand, the history of two or three members of a family suffering from the same disease may occasionally assist the diagnosis in a doubtful case of ringworm or scabies. The age, sex, and occupation of the patient should always be included in our consideration in dealing with this part of the subject, as these factors are not without their bearing on the development of certain cutaneous maladies.

We may sum up the foregoing remarks on diagnosis briefly thus: (1) Examine all parts of the body on which an eruption is present; (2) take a general view of the eruption regarded as a whole; (3) separate it into its component parts, and distinguish what is of the essence of the disease from what is superadded; (4) observe the regions affected; (5) investigate the subjective sensations; (6) ascertain the past and present history, and the general condition of the patient.

Treatment.—Little need be said on the treatment of skin diseases generally; each disease, and indeed one may say each case, requires special treatment of its own. A few points may, however, be mentioned which are of general application.

There are several different methods of treatment in common use: (1) The strictly local treatment by means of ointments, lotions, powders, bandages, and other appliances; (2) the treatment by various kinds of baths, including vapour and Turkish baths; (3) treatment by internal medicines; and (4) general treatment, including diet, rest, change of air, and other similar remedies.

With regard to the first of these, namely, treatment by strictly external remedies, it is all that is required in dealing with those skin affections which are entirely local—such, for instance, as scabies, ringworm, tinea versicolor. When, however, we attempt to cure diseases such as psoriasis or eczema simply by local means, though we may have little difficulty in getting rid of the eruption, the cure is usually of very short duration. For example, the cure of psoriasis by chrysophanic acid ointment, or of symmetrical eczema by ichthyol ointment, is usually followed by a speedy return of the malady. If, on the other hand, the local treatment is combined with the use of suitable medicines, and other more general remedies, especially such as have some definite or specific effect on the disease, we may reasonably hope for a more lasting cure; at all events, the results of experience prove that this is the case, whatever may be the therapeutical explanation of the fact.

Treatment by baths occupies an intermediate position between the strictly local and the general remedies, though no doubt they belong more to the former than to the latter category. They are especially useful in dealing with chronic scaly diseases, such as psoriasis, and also in the treatment of syphiloderma.

Lastly, some forms of skin diseases, such as gutta rosea and many kinds of eczema, are aggravated and perpetuated, if not produced, by indigestion, want of rest, and mental troubles and anxieties; therefore suitable diet, rest, and change of air and of surroundings, will not be without their influence in effecting a lasting cure.

Robert Liveing.

SKIN-BOUND DISEASE.—A popular synonym for sclerema neonatorum. *See* Sclerema Neonatorum.

SKIN-GRAFTING. — Skin-grafting consists in the transplantation of portions of skin of varying size and thickness from a healthy part of the body of the patient himself, or of some other person or animal, on to a recently made raw surface or a granulating sore.

Skin-grafting thus differs from a plastic operation, which involves the shifting of a flap of skin and subcutaneous tissue from one part of the body to another, without completely dividing its vascular connexions with contiguous parts.

Methods.—Several years ago Reverdin introduced the plan, which might more properly be called epidermis-grafting, of placing minute portions of the superficial layers of the skin, containing, however, the cells of the *rete Malpighii*, on a healthy granulating surface, to which they adhered and served as the starting-points for the spreading of epidermis over it. The grafts were shaved off from any healthy part of the skin with a sharp knife, the incision being barely deep enough to draw blood. They were then placed, with the deep surface downwards, on the sore, and not very far from one another, as each graft does not, as a rule, grow readily to a larger size than that of a sixpenny-piece. It is presumed that in all operations for skin-grafting close attention will be paid to keeping both the graft and the sore aseptic, the way of doing which will be given in a later paragraph. Neglect of this precaution exposes the grafts to the irritating influence of putrefaction, which much endangers their vitality.

More recently Thiersch has brought forward a great improvement on this method. It consists in shaving off with a razor a strip of the superficial parts of the skin (as in Reverdin's plan, going just deep enough to draw blood, but no deeper) one inch wide and of any required length, and preferably from a part where the skin is soft, such as the aspect of flexion of the arm. This strip is cut into pieces half an inch or more long, which are to be placed quite close together over the granulating or raw surface. If the former, the superficial granulations must be previously scraped away so as to remove any irregularities and leave behind only a material which, though highly vascular, is little prone to contract, because it has already contracted as much as is possible. The grafts must not be placed in position until all bleeding has stopped, and this result may be encouraged by exerting pressure with a sponge over a piece of some smooth material like the oiled-silk protective placed upon the wound. Mr. Cheyne has more recently still recommended that the whole thickness of the skin should be used for the grafts. This has the disadvantage that contraction must occur in the part from which the graft is removed, but the advantage that it is reduced to a minimum in the part to which the graft is transplanted. It should certainly be adopted in cases such as excisions of the mamma, where a piece of redundant skin from the axilla is used to fill a gap between the flaps on the front of the chest. The deep surface of the graft may be prepared by chipping off, with a sharp pair of fine scissors curved on the flat, any pieces of fascia or fat remaining adherent to it.

Precautions.—In performing the operation, the part from which the graft is to be taken must be purified by shaving it and washing it thoroughly with a solution of carbolic acid 1 to 20, of corrosive sublimate 1 to 500, or a mixture of the two; and, if any time is to elapse between its removal and its application to its new seat, it may be kept in a solution of boric acid heated to the temperature of the body. If it is to be placed on a surface which is already septic, this must be prepared by the application for a few days of a moist antiseptic application frequently changed, say, boric lint soaked in a 1 to 2000 sublimate solution; and it is often well to begin this treatment by purifying the skin with 1 to 20 carbolic acid lotion, and the sore with a solution of chloride of zinc, 40 grs. to 1 oz. A piece of oiled-silk protective should be placed on the grafts before the antiseptic dressing, whatever it may be, is applied. If the grafts be not placed close together, lines of granulations may form between them, and much interfere with the presentableness and stability of the scar.

Some surgeons have obtained the grafts from the skin of frogs and other animals, but we have not sufficient knowledge yet to speak positively in recommending this plan. The best and safest source of supply is undoubtedly the skin of the patient himself, for it has happened that both tubercle and syphilis have been transmitted when the graft has been taken from another person.

In *plastic operations* a flap of skin and subcutaneous tissue decidedly larger (as three to two) than the surface to be covered is turned up from some contiguous or distant part, but left attached by a sufficiently wide base to ensure its retaining its vitality. The flap is then shifted round and secured by sutures to the raw surface, which it must accurately fit. If the part from which it is to be transplanted be at some distance from that to which it is to be adapted, the part on which the latter is situated must be firmly secured in position until the flap has formed its new connexions, when the pedicle is to be divided, and the part to which it has now become adherent is allowed to assume its natural position.

Rickman J. Godlee.

SKODAIC RESONANCE.—A peculiar high-pitched resonance, found chiefly at the sterno-clavicular region of the chest, in some cases of pleural effusion and certain other conditions. The importance of this physical sign was first pointed out by the late Professor Skoda of Vienna. *See* Physical Examination; and Pleura, Diseases of.

SKOLIOSIS (σκολιός, crooked). — A synonym for lateral curvature of the spine. *See* Spine, Diseases and Curvatures of.

SKULL, Diseases and Deformities of.—Synon.: Fr. *Maladies du Crâne*; Ger. *Krankheiten des Schädels.*—The principal diseases and deformities of the skull will be discussed in the following order: (1) Changes of shape; (2) Variations in size; (3) Meningocele and Hernia Cerebri; (4) Cephalhæmatoma; (5) Inflammation; (6) Rickets; (7) Craniotabes; (8) Syphilis; and (9) Tumours.

1. Changes of Shape.—The shape of the skull not only varies much amongst the different races of mankind, but in each race variations are to be found, sometimes depending upon, sometimes independent of, disease in the individual. A glance at any extensive collection of crania is sufficient to indicate how much longer some skulls are than others, in proportion to their width; how in some the vertical diameter is proportionally great, in others small; how some have wide cheekbones, some depressed noses, and others projecting jaws. The old classification of Blumenbach has now been superseded by the numerous and minute observations of recent investigators. For a short account of the methods of craniometry now in use, and of the present transitional state of the science, the reader is referred to the tenth edition of Dr. Jones Quain's *Anatomy*, vol. ii. p. 82, where he will also find references to most of the important works upon the subject.

The skull is seldom perfectly symmetrical; the asymmetry being usually more marked behind than in front. This is shown not only by a coarse examination of the exterior, but by referring to the differences between the sulci and foramina on the two sides, which are so commonly met with. A familiar illustration is afforded by the fact that the nose is rarely, if ever, exactly in the mid-line of the body; but much more striking deviations from perfect symmetry may occur, as, for instance, in a case reported by Mr. Pearce Gould to the Pathological Society, in which one half of the cerebellum was absent, and there was a corresponding deficiency of the cerebellar fossa on the occipital bone. Many savage races produce abnormalities of the shape of the skull, by the application of external pressure during early infancy; and a similar result has been supposed to be consequent on the method of wrapping up the heads of children that is adopted in some parts of France. A marked asymmetry of the skull accompanies that rare disease, 'hemiatrophy of the face,' which is said by Mr. Hutchinson to be related in some way to morphœa. There are also recorded cases of hypertrophy of the bones of the face and skull. A remarkable instance of this disease, or rather of the development of enormous hyperostoses, was shown by Mr. Hutchinson, in his lectures on *Surgical Affections of the Nervous System*, at the Royal College of Surgeons. Here the hyperostoses appeared closely confined to parts which were supplied by branches of the fifth nerve. Some of these hypertrophic cases are, no doubt, examples of exostosis, others of inflammatory enlargement. An uniformly thickened skull, depending presumably, though not certainly, on the latter cause, may be either porous like cancellous bone, or dense and heavy like ivory. There is in the museum of the College of Surgeons an example of both varieties, each of which measures in many parts no less than $\frac{7}{8}$ in. in thickness; in the porous variety the sutures are usually more or less completely ossified. The writer has seen a case in which, without apparent cause, the growth of one half of the lower jaw appeared to be arrested about the age of puberty, which gave a peculiar inequality to the face. Great deformity of the skull may result from the constrained position in which the head is held by patients suffering from torticollis.

2. **Variations in Size.**—The size of the skull is also subject to considerable variations in different races. It is somewhat larger, on the average, in men than in women. Amongst individuals also there are very great differences. Great intellects have sometimes been associated with large crania, but oftener there has been no such relationship, and not infrequently the opposite has been the case. Far greater, however, are the modifications of size which depend upon pathological conditions and defects of development. Some of these are briefly as follows:—

(*a*) *Microcephalic idiots.*—Amongst this class of idiots, which must be made to include the cretins, the skull is remarkably deficient in size. Microcephalic skulls may be caused by a too early union of the sutures, in which case the want of development of the brain may be looked upon as a result of this synostosis; or there may be a normal condition of the sutures as regards union, but both the brain and the skull may remain undeveloped. The low forehead and animal face which are characteristic of this condition give a strangely repulsive appearance to the child. The degree of idiocy depends upon the size and structure of the brain, and the development of the convolutions. *See* CRETINISM.

(*b*) *Anencephalic monsters.*—This class exhibits a more or less complete deficiency in the development of the cranial bones, as well as of the brain. The great variety of abnormalities which may be met with will be found described in the article BRAIN, Malformations of.

(*c*) *Hydrocephalic infants.*—The skulls of these infants are of a size proportionate to the amount of fluid which is present, and they may thus sometimes reach enormous dimensions. The forehead reaches far over the face, so that the plane of the upper wall of the orbit is continuous with that of the perpendicular part of the frontal bone. The bones become excessively thin, and are often in part replaced by membrane. The sutures gape, and the fontanelles remain open far beyond the normal time of closure, occasionally indeed beyond the period of infancy. *See* HYDROCEPHALUS, Chronic.

In this connexion must be mentioned that extremely rare disease in children—hypertrophy and sclerosis of the *brain*, which involves a corresponding increase in the size of the skull. *See* BRAIN, Hypertrophy of.

3. **Meningocele and Encephalocele.** Closely related also to hydrocephalus are the cases of meningocele and encephalocele. It may briefly be stated here that they involve the existence of a deficiency at some point of the skull, through which the membranes of the brain, containing either cerebro-spinal fluid only, or some part of the brain itself, may protrude. The most frequent seat of this disease is the occipital bone, and the next in frequency the nasal part of the frontal bone, but tumours of this nature have been met with in other situations. It is of the highest importance to diagnose these two kinds of tumour from those developed in the bones of the skull or outside them; mistakes in diagnosis have not infrequently led to most disastrous results, as, for example, when a meningocele has simulated a polypus of the nose, and its removal has been undertaken. If patients who have suffered from meningocele or encephalocele recover—a most rare occurrence—a small hole may remain in the bone which presented the deficiency, or the opening may be completely obliterated.

4. **Cephalhæmatoma.** — True cephalhæmatoma is a collection of blood between the periosteum and the skull. It occurs congenitally, usually on the right parietal bone, but often on the left, and as a rule varies in size from an inch to two inches in diameter; and it is surrounded by a hard, well-defined margin, which at first consists merely of blood-clots, but, if absorption be long enough delayed, is ultimately the seat of a deposit of bone. It is probably in most cases, if not in all, the result of mechanical violence during delivery. An exactly similar condition is often seen as the result of a contusion in later life. If left alone, a cephalhæmatoma generally disappears. If suppuration have taken place, incision becomes necessary. *See* CEPHALHÆMATOMA.

The term 'cephalhæmatoma' might equally well be applied to collections of blood between the dura mater and the skull. Such effusions are probably always traumatic, and result from the rupture of a meningeal artery or vein. If serious results do not immediately follow from pressure on the brain, considerable thickening of the dura mater may be set up, accompanied by the symptoms known as those of pachymeningitis. *See* MENINGES, CEREBRAL, Inflammation of, Simple Traumatic.

5. **Inflammatory Diseases.**

(*a*) *Inflammation of the diploë and its veins.*—In cases of injury to the skull, whether of the nature of fracture or of simple exposure in a scalp-wound, inflammation of the diploic veins is not uncommon, if the wound be allowed to putrefy. In a bone so affected, if the outer table be removed, the whole diploë and its veins are found to be filled with pus, or, on applying a trephine, the pus may be seen to exude from the divided veins. The dura mater, under such circumstances, may be inflamed, or pus may collect between it and the bone. Pyæmia, with its characteristic concomitant symptoms, is the frequent, if not the invariable, result. It is not assumed that in this affection the outer and inner tables of the skull escape, but it is only in the diploë that the pathological process is obvious to the naked eye.

The only treatment that has been suggested—trephining—does not offer any hope of curing the disease.

(*b*) *Chronic osteitis.*—This may affect the bones of the skull without apparent cause, but in the majority of cases it depends upon the syphilitic taint. Sometimes all the bones of the skull become thickened and enormously massive, the surface being much roughened and often worm-eaten. At other times irregular hyperostosis may be the result. Considerable thickenings of some of the cranial bones, the result of an imperfect vascular osseous deposit, are found in some infants affected with congenital syphilis. These are mostly met with about the fontanelles, especially on the frontal and parietal, and sometimes the temporal bones. The irregular hyperostoses are mostly the result of local periostitis; in fact, they are ossified nodes. Chronic osteitis is the cause of the falling-in of the bridge of the nose, or the massive condition of the same part, which gives such a characteristic appearance to a child suffering from congenital syphilis. It is also the cause of some of the exostoses of the external auditory meatus.

The treatment must be directed against the constitutional taint, if any is to be discovered.

(*c*) *Caries.*—Chronic osteitis can hardly be considered apart from caries, which, again, in the majority of cases, depends upon syphilis, though less commonly on the strumous diathesis. It is usually caused by the penetration of a superficial ulcer into the deeper structures, or by the separation of the periosteum, resulting from periostitis. It is frequently associated with more or less chronic osteitis and necrosis. One of the most frequent seats of caries of the skull is the forehead, as a sequence of tertiary syphilitic ulceration (*corona Veneris*). Another common seat is the hard palate, which is often perforated as the disease advances. Caries may occur in the occipito-atlantal articulation (Pott's disease), followed by a train of symptoms which will be found discussed in other parts of this work. Caries of the temporal bone, either of the petrous or mastoid portions, frequently follows *otitis media*, and is not uncommonly the intermediate stage between this disease and thrombosis of the lateral sinus, meningitis, or cerebral abscess. It usually arises by extension of disease from the middle ear to the mastoid antrum and mastoid cells.

Treatment.—Beyond the administration of iodide of potassium and of mercury, the cautious scraping away of the diseased bone, and the adoption of precautions for maintaining cleanliness, little or nothing can be done to relieve syphilitic caries by the surgeon; and with regard to other cases of caries of the skull, whether considered pathologically or clinically, nothing can be added which does not apply to the same disease in other parts of the body. Caries of the occipito-atlantal articulation is best treated in the early stages by the actual cautery.

(*d*) *Necrosis.*—Necrosis of the skull not infrequently depends upon a traumatic cause, such as a scalp-wound or a burn; but here again the syphilitic form is exceedingly common. It may also depend upon disease of the middle ear. Simple traumatic necrosis leads to the separation of a sequestrum in the usual way. Syphilitic necrosis often depends upon some form of ulceration, or upon periostitis, and may be accompanied by extensive caries and chronic osteitis. It often affects the diploë and causes separation of the inner and outer tables. The separation of syphilitic sequestra is generally an exceedingly tedious process; and they are, moreover, often surrounded by little or no reparatory callus, so that after their removal it is no rare occurrence to find the dura mater pulsating over a large area at the bottom of the wound. At the same time, this rule is not invariable; it is common to find great thickening if necrosis of the bones of the orbit occur, which may cause permanent displacement of the eyeball. The writer has seen a large piece of the body of the sphenoid separated as a sequestrum, including the sella turcica, and removed through the nose without the slightest evil result to the patient. Tubercular necrosis sometimes causes death of the whole thickness of the skull, sequestra of varying size being thrown off and leaving the dura mater exposed.

Necrosis is not infrequently met with affecting the bones of the face. Thus a part or the whole of the upper or the lower jaw may die, and come away as a sequestrum. Necrosis of the jaws often depends on inflammation set up by carious teeth. It sometimes accompanies actinomycosis. Another cause, happily not now frequently met with, is the poisonous effect of the fumes of phosphorus in persons employed in the manufacture of this substance, and in that of lucifer matches (*see* Phosphorus, Poisoning by). The same remarks apply to the abuse of mercury. But, besides these more special causes, necrosis of the bones of the face may depend upon those more general states which are supposed to stand to necrosis of other bones in the relation of cause and effect; such as fevers and the like. The amount of thickening round a necrosed upper jaw has not infrequently led to its removal in mistake for a tumour; it is, therefore, of the highest importance to examine all swellings in this region with great care.

Treatment.—If the membranes be left exposed, some protection must be provided for the cranial contents; in other respects the treatment of necrosis of the skull must be conducted on general principles. Sequestra in the mastoid process or around the tympanum should be carefully dealt with, on account of the danger of setting up meningitis or injury of the internal carotid or lateral sinus which any surgical interference involves. In dealing with necrosis of one half of the lower jaw it must be remembered that, unless sufficient callus have been thrown out before the removal of the sequestrum, the other half will lose its support and assume an altogether unnatural and almost useless position, being drawn to the opposite side and leaving the patient in a condition in which he can hope for but little relief from surgery.

(*e*) *Periostitis.*—Periostitis of the skull has been already referred to. It may depend upon syphilis or struma—most commonly the former; and give rise to what are known as *nodes.* The inflammatory subperiosteal effusion may be fluid or solid (*soft* and *hard* nodes); and it may undergo true or spurious suppuration or ossification, or may be completely absorbed. The most common but by no means the invariable position for cranial nodes is the frontal bone. As in the case of periostitis elsewhere, nodes are the seat of characteristic nocturnal pain, which is extremely distressing and exhausting to the patient.

Treatment.—The treatment in any case is by the administration of iodide of potassium; the effect of which is most marked, however, in syphilitic cases, the pain being usually removed in two or three days. If suppuration occur, incision may be required.

6. **Rickets.**—In a rickety infant the skull looks large; though it may be questioned whether this appearance does not depend on a deficient development of the bones of the face. The frontal and parietal eminences appear too prominent; the fontanelles remain patent much longer than in a healthy infant; and in some cases the anterior fontanelle may be unclosed as late as the fourth or even sixth year. The skulls of rickety children have a peculiarly massive feel; they are sometimes long in proportion to their width, conforming to the shape known as dolicocephalic. (For a more detailed account of this and other conditions see a paper by S. J. Gee, M.D., in vol. vii. of the *St. Bartholomew's Hospital Reports*, on 'The Shape of the Head looked at from a Medical Point of View.') The head of an adult who has been the subject of rickets in his childhood has often a very characteristic appearance: an apparently large square skull, with a prominent forehead towering above a diminutive and pinched-up face, giving to the individual a decidedly intellectual aspect.

Craniotabes occurs occasionally in rickety skulls, but, as will be afterwards shown, we do not yet know how far, if at all, it depends upon the constitutional condition.

7. **Craniotabes.**—By this term is meant the occurrence of spots of remarkable thinness in the skull, such that an indentation may be produced by the pressure of the finger. True craniotabes, as opposed to the gelatiniform degeneration of the outer table (Parrot), attacks the inner aspect of the skull. For its production an undue softness of the bone appears to be necessary, together with the occurrence of pressure, either from within or from without. It is rarely found congenitally, and it then affects the anterior part of the skull. It is common in syphilitic infants under one year of age, and is then usually met with in the posterior parts of the parietal bones. These positions, it will be noticed, are those most subjected to pressure under the two conditions mentioned. Craniotabes has been, by some observers, associated with rickets, but the relation of the one to the other is at present doubtful. It disappears as age advances, and requires no special treatment. *See* M. Parrot, *Revue Mensuelle*, 1879, p. 769; and Dr. Barlow and Dr. Lees, *Path. Trans.*, 1880, p. 236, and 1881, p. 323.

8. **Syphilitic Affections.**—From the foregoing observations it will be seen that syphilis, congenital or acquired, has much to account for amongst diseases of the skull. It may cause periostitis, with consequent nodes; chronic osteitis, with consequent hypertrophy, local or general; caries; necrosis; and craniotabes. As a general rule, it may be stated that syphilitic affections of bone are amongst the later manifestations of this disease. The inflammatory forms are usually accompanied by severe nocturnal pains, and they may be expected in most cases to yield to the administration of iodide of potassium.

9. **Tumours.**—It is necessary to refer in the briefest possible way to the tumours of the skull. Primary growths may spring from the diploë, or from the inner and outer tables of the cranial bones. Perhaps the most common are exostoses and some of the various kinds of sarcoma, either of which may reach an enormous size. The former may assume various characters (*see* Tumours). A remarkable instance of one presenting the appearance of a horn will be found described in the *Transactions of the Pathological Society of London*, vol. iii. p. 149. These alone, and then only in certain cases, admit of removal by the surgeon. In connexion with the bones of the face, tumours of the antrum or of the upper jaw, of various kinds, and tumours of the lower jaw, are not uncommon. In the latter position the various forms of epulis—myeloid, fibrous or malig-

nant, and cystic tumours, are frequently met with. Exostoses often grow from the jaws and the orbit, and in connexion with the former the different kinds of odontoma must be mentioned. Secondary tumours of all kinds may affect the skull; thus more than one instance is on record of a pulsating growth, occurring secondarily to a similar growth in the thyroid gland; and scirrhus, following cancer of the breast, is by no means unknown. Of these secondary affections the commonest are those which affect the skull by the direct extension of tumours from within or without; for example, the epitheliomata of the scalp or mouth, or rodent ulcer of the face. R. J. Godlee.

SLEEP, Disorders of.—Synon.: Fr. *Troubles du Sommeil*; Ger. *Stöhrungen des Schlafes.*—A proper amount and kind of sleep is needful in order that the body may be maintained in a state of health. But the actual amount of sleep taken and necessary for persons in health varies, within wide limits, according to age, the soundness of the sleep itself, and individual idiosyncrasy.

Age is a very important modifying factor. Thus an infant may sleep for twenty hours out of the twenty-four, and young children up to the age of ten commonly sleep for fourteen or at least twelve hours. In children from ten to fifteen years old, the duration of sleep usually varies between twelve and ten hours. In persons from fifteen to twenty-five the period should not sink below eight hours; from the latter age on to fifty it may fall to seven hours; and after this age about the same amount of sleep is required by the majority of persons, though some find six hours sufficient, and a few can (without apparent injury) take habitually even as little as five hours' sleep. The instances in which a duration of sleep habitually less than this is needed are altogether rare and exceptional.

Soundness of sleep, too, is subject to much individual variation. In childhood and in early life, sleep is commonly more profound than it is in adults, and much sounder than in old age. But, over and above these variations incident to age, there are individual differences; some persons are naturally 'light' and others 'heavy' sleepers. As a rule, those who can do with a small amount of sleep belong to the latter category. And similarly in regard to amount there are individual differences: some persons are able to do with a comparatively small amount, while others seem to require to sleep decidedly beyond the average periods above stated.

The disorders of sleep—that is, the variations outside the above limits—belong to three principal categories, in the first of which may be ranged all those cases where sleep is *excessive* in amount; in the second those in which it is *defective* in soundness or in amount; and in the third those in which it is *unnatural in character*.

I. Amount of Sleep Excessive.—This occurs commonly in more or less demented persons or in idiots, whose brain-activity is below the usual level. Such persons, when their natural wants are satisfied, are apt, like many of the lower animals, to sleep away a large portion of their time.

But some individuals of notable intellectual power may occasionally, even in a state of health, though after greatly prolonged labours with previous deprivation of rest, continue to sleep soundly for twenty-four or even thirty-six hours.

In many brain-affections, and in some cases of blood-poisoning, a condition of unnatural sleep bordering upon stupor may be present for many days. Obscure cases in which sleep is prolonged for weeks, or even months, are occasionally met with in this country. This rare condition only supervenes in persons of an obviously 'nervous' temperament, and the state itself seems generally to be a kind of trance allied to catalepsy.

Occasionally an excessive tendency to sleep for the greater part of the day is set up in middle-aged persons without other very distinct accompaniments or apparent cause. Some years since the writer had such a case under his care for several months in University College Hospital. No cause could be ascertained, and this patient was almost constantly asleep, except when taking food, or when he was being engaged in conversation. His pupils were habitually contracted, and his memory was very defective, but there was no paralysis of any kind. Before death his temperature on several occasions sank for many hours as low as 92° F. At the necropsy, the brain, as a whole, was found to be distinctly wasted. There was no definite focal lesion, though the pons was thought to be more indurated than natural.

On the West Coast of Africa a curious endemic disease occurs, known as the *sleeping sickness* (*see* Gore, *Brit. Med. Journ.*, Jan. 2, 1875), the ætiology and pathology of which is altogether obscure. It begins with a swelling of the cervical glands, together with an increasing tendency to sleep. The somnolence becomes more and more constant, until at last the patient cannot even be aroused to take nourishment. The disease lasts from six to twelve months, and is generally fatal. *See* Negro Lethargy; and Trance.

II. Amount of Sleep Defective.—Under this head we have to do with two kinds of failure—a defect of quality (*disturbed* or *restless sleep*); and a defect in quantity (*wakefulness, insomnia, pervigilium*). These two defects often co-exist, though in many cases we may have the former condition existing alone.

(*a*) *Disturbed* or *restless sleep.*—This is a very common complaint, apt to occur in persons of all ages, and under the influence of many different causes, some of the most frequent of which are these: Indigestible food, or food of excessive or unaccustomed quantity, taken not long before going to bed; painful conditions of any kind, whether due to mere neuralgia or to serious organic disease of this or that organ; discomfort induced by undue cold or excessive heat; mental excitement or worry; chronic alcoholism; the menopause; prolonged overwork (mental); over-fatigue (bodily); febrile conditions; inflammations; gouty states of the system; imperfect action of the liver and various forms of dyspepsia; excessive hæmorrhages; acute and chronic illnesses of various kinds, such as delirium tremens, bronchitis, polyuria, and different forms of heart-disease; the state of convalescence from many acute diseases; the taking of tea or coffee, either too strong or too late at night. Lastly, sleeping in a novel or uneasy condition, or in the midst of unaccustomed noises, may also be mentioned as a not infrequent cause. Under any of these various conditions sleep may be fitful and disturbed, the persons often starting or turning about uneasily, dreaming much, and from time to time waking under the influence of dreams of a distressing or oppressive character. In one of the most extreme of the latter conditions, especially when it has been evoked by indigestible food, the state known as *nightmare* is induced. *See* Nightmare.

Treatment.—The treatment of disturbed sleep must of course vary widely according to the nature of the influences under which it has arisen. These may at times be easily corrected, but in other cases, where the disturbed rest is dependent upon pain difficult to annul, or upon some acute or chronic disease, it may be impossible or extremely difficult to ensure sound sleep, notwithstanding the best-directed efforts to correct or neutralise the disturbing causes in operation. It may then be necessary to have recourse to some of the measures recommended under the next heading.

(*b*) *Insomnia* or *wakefulness.*—Under this head we may have either complete or partial insomnia. The condition is complete when the person gets no sleep at all for night after night, as in acute mania, delirium tremens, in those suffering from some very severe pain, or in persons under the influence of profound grief or mental anxiety. On the other hand, we may have partial insomnia of different kinds. In the one set of cases the persons who suffer from it may lie awake for long periods (one to several hours) before being able to get to sleep at all, and then sleep may be more or less sound and continuous till morning. In other cases, patients do not experience so much difficulty in getting to sleep, though after they have slept for one, two, or more hours they awake and cannot again fall asleep; they lie awake often in a state of mental depression, or even actually tortured by gloomy or horrible forebodings.

Various cases are on record in which absolute insomnia has lasted not only for days but even for weeks, interrupted only by mere snatches of sleep during brief intervals.

In this whole class of cases, however, the sufferers themselves are apt to form exaggerated estimates of the amount of their wakefulness, and to become more or less hypochondriacal upon the subject.

Treatment.—In many of these cases the art of the physician is very severely taxed. Whenever it is possible, insomnia should be corrected by a studious attention to the general health and habits of the patient, and by endeavouring to ensure the presence, as far as possible, of the physiological conditions which favour sleep. Mental repose, bodily comfort, a sufficient degree of warmth, a certain amount of fatigue, combined with perfect quietude—one or more of these conditions will be found in different cases either important aids or essentials for the production of sleep. To ensure the first of these conditions, it may be needful to prohibit all study for some hours before retiring to rest. An evening walk, so as to induce a certain amount of bodily fatigue, is, where it can be had recourse to, often beneficial; whilst in other cases a warm bath at bedtime, followed by friction of the skin, may greatly facilitate sleep. Sometimes a mere hot foot-bath, with or without mustard, will prove beneficial. A cup of warm beef-tea, gruel, or some weak stimulant (such as hot whisky and water) just before going to bed may also have a salutary influence, and the former may be repeated, or taken preferentially, during the night. Monotonous sensorial impressions (sounds or gentle frictions); or a monotonous dwelling of the mind upon certain uninteresting imaginary sights or verbal repetitions are, again, sometimes found to act as provocatives of sleep, though in other cases they completely fail.

In debilitated or neurasthenic conditions of the system, a patient's ability to sleep may often be greatly improved by the administration of such nervine tonics as arsenic and strychnine in combination with digitalis or sumbul; and some patients suffering from worry or overwork have derived great benefit in the way of improved sleep by taking spirit of turpentine (♏30) in capsules at bedtime.

Where the preceding measures are unavailing, recourse must be had to hypnotics and sedatives, such as bromide of potassium, chloral hydrate, opium in one or other of its forms, morphine, Indian hemp, amorphous hyoscyamine, hyoscine, &c., in doses appropriate to the age and condition of the patient.

In the more urgent cases the doses of such hypnotics may have to be repeated till sleep is procured; but in many of these urgent conditions the sedative influence of packing in the wet sheet must not be forgotten.

Several other most useful remedies of this class have been in use during recent years, the most important of which are sulphonal, paraldehyde, chloralamid, and one which has been more recently introduced, namely, chloralose. Of these, sulphonal (gr. 15–30) is best given in the form of cachets or crushed tabloids about an hour and a half before bedtime. It often acts well, and produces less depressing effects than chloral hydrate. Paraldehyde (♏30–60) is a very safe hypnotic to give where such a drug is required in patients suffering from heart or lung disease, but the great objection to it is its very nauseous taste and odour. Chloralamid (gr. 20–45), given in an acidulated solution, is free from these objections, and is almost equally safe; and it would appear that the same may be said of chloralose, the dose of which (gr. 5–15 in hot water) is smaller than that of either of the other drugs just mentioned. It is said to produce prolonged and restful sleep, and not to lead to disagreeable after-effects on awaking. Such remedies, however, ought never to be taken except under the orders and directions of a medical man, who alone would be able to judge as to the most suitable drug, the proper dose, and the mode of its administration. With some of these drugs, a dose on alternate nights is found to be sufficient; and in all cases it is of the greatest importance to obtain the desired result with the minimum quantity that will prove effective. Again, wherever hypnotics are had recourse to, it is of great importance to see that their use is not continued after the need for them has passed. It not infrequently happens, for instance, that much of a patient's insomnia may be due to a bad habit of the system, which yields after it has been broken in upon by the use of hypnotics for a short period. Abrupt discontinuance is generally most inadvisable; there should rather be a gradual diminution of the dose, with or without the knowledge of the patient.

III. Sleep Unnatural in Character.—Under this head we have to do with various unnatural conditions, in which the abeyance of brain functions that exists during sleep is more partial than that which normally exists. In disturbed sleep the physiological condition pertaining to and provocative of sleep is generally less profound than it should be, just as in other cases of unusually deep sleep (akin to stupor) such a condition is generally more profound than natural. In the cases to which we now refer, however, sleep is partial in its area: portions of the brain that are usually involved in the physiological condition peculiar to sleep remain exempt, so that the sleeper exhibits powers which sleep usually annuls. Hence we may have *somniloquy* or *sleep-talking*; and *somnambulism* or *sleep-walking*.

In those who exhibit the former phenomena, dream-thoughts are capable of evoking correlative acts of speech, and such persons will sometimes allow a listener to hold a sort of conversation with them, of which in the waking state they recollect nothing. This dream-conversation may be more or less coherent. Dreams themselves, too, vary much in their coherency in different individuals. In some persons, whose sleep is to that extent unnatural, powers are displayed during this condition which even surpass those of the waking state. Mathematical problems have been solved during such sleep; poems and music have been composed and written out, which have altogether surprised the same person when awake. The writer has recently seen a young lady liable to what may be termed 'singing fits,' in which she would lie for hours incapable of being aroused by ordinary means, singing, without intermission, songs, hymns, and portions of operas in promiscuous succession, but in a manner decidedly excelling that of which she was capable when awake. In all these states we have to do with a morbid condition of sleep, partial in its area, and in which there is the further peculiarity that certain faculties are in a condition of exalted activity. The alliances here are intimate with the conditions that are now studied under the name of 'hypnotism,' but which were formerly included under the term 'animal magnetism.' *See* MAGNETISM, ANIMAL.

Many of the above remarks apply to somnambulism also. Here the morbid sleeper possesses an unwonted power of calling his muscles generally into activity in response to his dream-thoughts. Sight in relation to the dream may be good, though unrelated visual impressions are not taken cognisance of. Muscular sense-impressions also are freely acted upon; but the sleep-walker may be quite deaf to all ordinary auditory impressions.

TREATMENT.—These are to be regarded as distinctly morbid conditions, and the persons manifesting them may often be cured by attention to the general health, and the use of remedies calculated to give tone to, and allay the irritability of, the nervous system. A line of treatment, in fact, not very dissimilar from that to which one would have resort in convulsions or epilepsy will often suffice to cure these minor manifestations of nervous disorder.

Finally, sleep may be disturbed by certain phenomena occurring to the person whilst he is actually in this condition, which, though scarcely to be spoken of as disorders of sleep, ought at least to be mentioned in this article.

One of minor significance is snoring, which at times may be so loud as to awaken the sleeper; but another of far greater significance is the occurrence of convulsive or epileptic attacks, which in some patients occur only during sleep.

H. CHARLTON BASTIAN.

SLEEPING SICKNESS.—*See* NEGRO LETHARGY.

SLOUGH (Sax. *slog*, a foul hole or hollow).—The dead material resulting from gangrene, ulceration, or low forms of inflammation of soft tissues. A slough may be in the form of a mass, as in gangrene; or in shreds, as in ulcers and unhealthy wounds, which are then said to be *sloughing*. *See* GANGRENE; ULCER and ULCERATION.

SMALL-POX.—SYNON.: Variola; Fr. *La petite Vérole*; Ger. *Blattern.*

DEFINITION.—An acute infectious disease, characterised by an eruption of pimples on the forehead, face, and wrists, which in from ten to fourteen days passes through the stages of vesicle, pustule, and crust; it also appears on certain mucous membranes; and is sometimes complicated with hæmorrhage into the skin, and from the mucous surfaces.

ÆTIOLOGY.—When, where, or how small-pox arose is not known. It certainly appeared in Europe in the sixth century. It arises now from contagion and from inoculation. It affects all races of men, every age, and both sexes. No climate is free from its ravages. It rages with special virulence where it appears for the first time, and in such cases may carry off whole tribes. It is exceptionally severe among negroes and the inhabitants of warm climates generally. Its subjects are unvaccinated or badly vaccinated persons, extensive observation having shown that in proportion to the efficiency of vaccination are the rarity and mildness of small-pox. As a rule, it attacks the same person once only, but there are exceptions to this rule. Some few—of whom Morgagni, Boerhaave, and Diemerbroek are said to have been instances—are insusceptible of small-pox.

ANATOMICAL CHARACTERS.—Small-pox is the result of a specific morbid poison, which, after a period of incubation of about thirteen days, possibly sometimes less, manifests itself by high fever and an eruption on the skin. The eruption is sometimes preceded by rashes of an erysipelatous, scarlet, or measly character, chiefly seen on the lower abdomen, the groins, and the upper and inner part of the thighs, along the sides of the chest and about the axillæ. Sometimes they are seen upon the face and neck, and occasionally they cover the body. They are distinguished from the hæmorrhagic rashes by the absence of blue-black spots, and are usually associated with the milder cases. 'As regards the skin-eruption, the papules are due, in the first instance, partly to punctiform hyperæmia of the cutis, over which the epidermic cells, and more especially those of the superficial portion of the rete mucosum, become swollen. By degrees, serous fluid is poured out into the substance of the affected epidermis, raising the horny layer from the swollen group of cells below, but detaching it imperfectly, so that a number of small irregular intercommunicating serous cavities are produced. But soon suppuration occurs in the subjacent rete mucosum, and the pus-corpuscles then rapidly diffuse themselves, and the pock is converted into a pustule. The umbilicated character which is so common is due to the presence either of a hair or of a sudoriparous gland, the connexion of which with the subjacent true skin has not yet been destroyed. The suppurative process need not implicate the true skin below; but not infrequently it involves and destroys it to a greater or less depth, and is prolonged inwards along the hairs or glands. Under the former circumstances the pustule leaves no permanent trace; under the latter a depressed cicatrix results, presenting numerous pits upon its surface.' (Bristowe, *Theory and Practice of Medicine.*)

Post-mortem examination shows nothing, beyond external appearances, special to small-pox, except a trace of eruption on the larynx and vocal cords. The blood is in most cases imperfectly coagulated, and in black cases not at all. In the latter ecchymoses of the mucous and serous membranes will be found. Pleuritic effusions and pneumonic consolidations are sometimes found, but the most common lung-complication is broncho-pneumonia. In *variola hæmorrhagica pustulosa* hæmorrhage is generally found in the substance of the lungs, heart, kidneys, and liver.

SYMPTOMS.—Small-pox may be described under seven forms: (1) Discrete; (2) Confluent; (3) Hæmorrhagic; (4) Malignant (Pure Hæmorrhagic); (5) Inoculated; (6) Small-pox after vaccination and revaccination (Modified); (7) Small-pox after small-pox.

1. Discrete.—In the discrete form the disease begins with rigor, fever, lumbar pain, headache, and sickness, with copious perspirations; followed by an eruption on the forehead, face, and wrists. This is usually most abundant on these parts, next most abundant on the hands and feet, and least so on the limbs and trunk. The eruption is followed by a remission of the general symptoms, and a fall of temperature, which continues until about the eighth day. Between the third and the eighth days the pimples appear on the extremities and the trunk, and change into greyish-white vesicles, circular, flattened, depressed in the centre, and surrounded by a red ring. During this time also vesicles may be seen in the mouth and the upper part of the pharynx and larynx, and there will be some soreness in these parts. On the eighth day some of the vesicles become pustular, lose their central depression, and become globular, whilst the redness which surrounds them becomes more marked. With this change the temperature rises, and the general symptoms return; but these are of short duration, for the pustules either dry up rapidly and form scales, or burst and form scabs; the temperature falls by about the tenth day; and the patient is then convalescent, fatal results being extremely rare, except in unvaccinated children under one year. When the crusts have fallen, and the desquamation which follows them is complete, there will often be pitting.

2. **Confluent.**—In this form the initial symptoms are essentially the same as the former, but more severe. The eruption appears about the same time, and in the milder varieties is discrete until the disease has reached the vesicular or the pustular stage; but in the more severe forms it is confluent from the first, and instead of showing distinct closely packed papules, the whole face is swollen, presenting the appearance of a tense elastic mass. When the eruption is well out the temperature falls, and the general symptoms remit, but to a less extent than in the discrete variety, and this remission continues until about the eighth day. Up to this time more or less delirium is present in many cases, and it is sometimes maniacal and suicidal in character; drowsiness and stupor sometimes take its place, and occasionally alternate with it. On this day, the eighth, the vesicles begin to become pustular, the areola to deepen, the temperature to rise, and the general symptoms to return. At the same time the face becomes extremely swollen; the eyelids close from œdematous swelling; saliva flows copiously from the mouth; the glands and the subcutaneous tissue of the neck and lower jaw enlarge; and the early delirium usually disappears. One of three things may now take place: (1) the disease may go on regularly to the eleventh day; (2) the development of the pustules may cease, the face remaining flat, of an opaque white colour; or (3) hæmorrhage may take place into the skin beneath the vesicles, and from the mucous membranes, that is, it may become hæmorrhagic-pustular. In either of the last two events death is almost invariable, and often rapid. In the first the swelling of the face increases for the next three days, during which time the vesicles become pustular, and the hands and feet swell. There will be increased sore-throat, increased salivation, great thirst, sleeplessness, delirium, rising temperature, and occasionally laryngitis. On or about the eleventh day the temperature and the general symptoms will have reached their height, the pustules will discharge their contents, and crusts will form. After this, in favourable cases the temperature will begin to fall, and the symptoms of the so-called 'secondary fever' to decline. By the fourteenth day crustation will be complete on the face, where it is most commonly found, the general symptoms will have disappeared, the temperature will have become normal, and convalescence established. In unfavourable cases it is about this time, the eleventh day, that death usually occurs. It is preceded by low delirium, variable temperature, subsultus, involuntary motions, and occasionally hæmorrhage into the skin and the pustules. When the crusts, which in this form are often retained many weeks, fall off, and when the desquamation is complete, there is pitting, which, at first of a reddish-brown colour, in process of time becomes white.

3. **Hæmorrhagic - Pustular, Vesicular, or Papular.**—This form of small-pox constitutes the connecting-link between the confluent and the malignant. With the latter it is often confounded, and hence true malignant has sometimes been said to end in recovery. It is characterised by hæmorrhage into the skin beneath the vesicles or the pustules. There are generally petechiæ, sometimes ink-spots, and often subcutaneous hæmorrhage. Recovery is very rare. Death may take place in the vesicular or the pustular stage.

4. **Malignant.**—SYNON.: *Variola Nigra*; *Variola Hæmorrhagica*; Black Small-pox; *Purpura Variolosa.*—This form is invariably fatal. Its distinguishing features are hæmorrhage into the *skin*, and irregularity in the form of the eruption. The illness commences with the ordinary symptoms, but accompanied by marked lumbar pain, præcordial anxiety, and coldness of the extremities. This is followed, about the third or fourth day, by ecchymosis into the conjunctivæ, and a purpuric or scarlatiniform rash sometimes covering the whole body, but most marked over the lower abdominal region, and the upper and inner part of the thighs, in which rash large and small dark blue, deep violet, or black spots are seen. The ordinary eruption is almost entirely absent. In the majority of cases it is limited to a few scattered papules, more often found on the fingers and toes than elsewhere. With these appearances there will often be found on the skin hard tumours, of variable size, of the same colour as the spots; and from one or more of the mucous surfaces there will be bleeding. Death sometimes takes place as early as the third day, but most commonly on the fifth. The temperature usually fluctuates about 102° (F.), sometimes reaches 104°, and is sometimes nearly

normal during the whole course of the disease. The mind is almost always clear throughout. This form of small-pox occurs at all ages, and in both sexes. It is never found in well-vaccinated subjects under fifteen, nor in those who have been efficiently revaccinated about that age.

5. **Inoculated.**—On the second day of inoculation a pimple rises, which by the fourth has developed into a vesicle, and by the seventh or eighth into a pustule, when the patient has rigors, swelling and pain in the axillary glands, and more or less fever, followed on the eleventh day by the ordinary small-pox eruption (Bristowe), which passes through the usual stages. The inoculated pustule attains full development on or about the eleventh day, and by the fourteenth there will be a crust. The characteristic of the disease thus induced is its mildness. It protects from small-pox in the same degree as first attacks of that disease protect from second attacks. The objections to it are (1) that small-pox so induced is infectious; and (2) that it is sometimes fatal.

6. **Small-pox after Vaccination and Revaccination.**—(*a*) *After vaccination.*—Speaking generally, it may be said that *good* vaccination protects from small-pox, and that when it does not protect absolutely it renders the disease milder and the disfigurement less marked, and reduces the mortality directly as the efficiency of the vaccination and revaccination. Persons under fifteen years of age with two good cicatrices are very rarely the subjects of severe small-pox; and if they contract it, death is almost if not quite unknown. After this age, however, certain, chiefly inefficiently vaccinated, persons become again susceptible, and the disease in some of these is occasionally severe. Post-vaccinal small-pox may be described under the following three forms: (1) In one class of cases there is more or less feeling of illness, headache, slight fever, possibly some lumbar pain, followed on the third day by a sparse eruption of papules, which abort and soon disappear. (2) In another class there are severe initial symptoms, followed on the third day by an eruption of papules, and a remission of the fever. On the fifth day the papules will have become vesicles, which in a day or two dry up without any recurrence of fever, leaving the patient convalescent at the end of the week. (3) In a third class the initial symptoms are very severe, sometimes indistinguishable from those of confluent small-pox, and they last forty-eight hours, after which an abundant eruption comes out, the whole face swelling as in severe confluent. The temperature now falls, and the disease in some cases will abort at this stage; in others it will go on to the vesicular stage and then abort, the patient becoming convalescent about the end of a week, without any recurrence of fever. In the case of adults who have been vaccinated only in infancy, and in children who have been badly vaccinated, the disease may run an unmodified course and end fatally.

(*b*) *After revaccination* (successful).—Small-pox, after this, is practically unknown. During the epidemic of 1871, 110 persons were engaged in the Homerton Fever Hospital in attendance upon the small-pox sick; all these, with two exceptions, were revaccinated, and all but these exceptions escaped small-pox. The experience of the epidemic of 1876–77 was of the same kind, all revaccinated attendants having escaped, whilst the only one who had not been vaccinated took the disease and died of it. So, in the epidemic of 1881, of 90 nurses and other attendants of the Atlas Hospital Ship (small-pox) the only person who contracted small-pox was a housemaid who had not been revaccinated. At the same time a single efficient revaccination about puberty is not, in the writer's opinion, an effectual protection, even against death, for all time.

7. **Small-pox after Small-pox.** — Second attacks are occasionally met with among adults. In the writer's experience they have invariably been mild; but fatal cases are said to occur.

Course, Termination, Complications, and Sequelæ.—In the discrete form of small-pox the great majority of cases recover; half of the confluent cases die about the eleventh day, and the malignant cases invariably die. In small-pox modified by vaccination the course of the disease will depend upon the quantity and quality of this, as shown by the marks. If these be of the best kind, three or four in number, and in a patient under fifteen, the disease is invariably mild. In some, however, who have passed puberty, the best primary vaccination loses in power; but, nevertheless, it almost invariably modifies the disease, and when death occurs it is usually due to some accidental complication. Of complications, laryngitis, bronchitis, pneumonia, and in particular broncho-pneumonia, are the most common. Glossitis occurs occasionally. On two occasions the writer has met with cerebral symptoms, which were shown after death to depend upon cerebral hæmorrhage. Aphasia with right hemiplegia he has seen twice; and once a condition like dementia, shown after death to depend upon thrombosis of the basilar artery. In the cases of cerebral hæmorrhage the eruption was not fully developed, but at the time of death they did not seem likely to become cases of extreme confluence. One was in a girl twenty-one years of age, with two good vaccination marks; and the other in a boy of eight with four fair marks. In both cases the event occurred in patients who suddenly became dangerously ill, and the seriousness of whose illness could not be ascribed to a small-pox which was by itself mild. It may be that this would be found to be the *immediate* cause of death in other cases, if *post-mortem* examination were more frequent and complete. It has been said that small-pox is occasionally complicated with scarlatina or measles; and it is true that *eruptions* indistinguishable from those of scarlatina and measles appear in some cases of variola; but whether the presence of such eruptions, which are but *one* symptom, constitute evidence upon which to maintain the co-existence of two specifically distinct diseases may be doubted. Pregnancy has been said to be a grave complication of small-pox. It is certain, however, that many pregnant women recover without injury; but abortion in confluent cases is often fatal, on account of the attendant bleeding. Of sequelæ the most common is pitting. Mania and dementia are occasionally seen. Erysipelas, abscesses, gangrene of the extremities, particularly the tips of the hands and feet, enlargement of the glands of the neck, conjunctivitis, iritis, perforating ulcer of the cornea, are not uncommon, and then occasionally one or both eyes may be destroyed. The specific small-pox eruption, however, never appears on the corneal conjunctiva. The changes which take place in the eye are late in the disease, and in all probability due to defective nutrition. Otitis, parotitis, orchitis, and ovaritis occur sometimes; and pyæmia occasionally.

Diagnosis.—This cannot be made with certainty until the eruption appears. Fever, headache, lumbar pain, and vomiting during the time of an epidemic of small-pox, should arouse suspicion; and should these be followed after forty-eight hours by an eruption of papules on the forehead, face, and wrists, the diagnosis may be considered certain. The difficulty of exact diagnosis depends on the fact that in many cases all the main features are not present together, and that one begins to trust to the existence of some one prominent symptom. Fever with headache, backache, and vomiting *may* occur in continued fevers; but the later appearance of the eruption, and the fact that it is not found in the situations in which that of small-pox occurs, ought to negative the idea of small-pox. Small-pox is occasionally preceded by eruptions which simulate those of measles, scarlatina, or erysipelas, and these eruptions are associated with fever and other symptoms of constitutional disturbance. If the disease be small-pox, the eruption will change within twenty-four or thirty-six hours, or will show signs of malignancy. Pyæmia, glanders, and acute rheumatism with a pustular eruption, may also be mistaken for small-pox, but attention to the *history of the case* will be enough to enable one to form a correct opinion. So far as eruption alone may lead to error, the point for diagnosis turns on the query, Could the eruption have reached, or would it not have gone beyond its existing stage, if the disease on which it depended were small-pox? Of eruptions unattended by general symptoms, syphilides, acne, eczema, erythema, and urticaria are most frequently mistaken for small-pox; but mistakes of this kind may in most cases be avoided by a careful consideration of the history. Lumbar pain is found with fever in pneumonia, but physical examination of the chest ought to settle the question; moreover, there is no eruption beyond occasional herpes. In lumbago there is no fever. Labour-pains are unattended by fever; moreover, they usually come on gradually and in the belly first, and are not constant. It must be borne in mind, however, that pregnant women, when suffering from small-pox, may have labour-pains and the initial symptoms of small-pox concurrently. Cases of black or malignant small-pox will present little difficulty; but if scarlatina, measles, and typhus prevail at the same time, there will be great difficulty in arriving at an exact diagnosis as to which form of malignant fever exists in the case under observation. The diagnosis from chicken-pox has been treated of in that article. *See* Chicken-pox.

Prognosis.—This will have been gathered from what has preceded. Small-pox is most fatal in unvaccinated children under five, and in adults over thirty. At these periods of life half or more may die. The lowest mortality in the unvaccinated occurs from ten to fifteen. The discrete form is rarely fatal in adults, but it is so occasionally when it occurs in unvaccinated children. Half of the confluent cases will die, and of the malignant all, and nearly all children under one year, whatever form the disease may assume. As regards vaccination in prognosis, it may be stated generally that the unvaccinated will die at the rate of about 50 per cent., the badly vaccinated at the rate of about 26 per cent., and the well vaccinated at the rate of about 2·3 per cent. *See* Vaccination.

Treatment.—There is no specific for small-pox, its complications or sequelæ, and the treatment is therefore to be conducted on general principles. The following are points of importance: (1) The patient should be placed in a large, well-ventilated room. He should be fed at intervals on easily digestible food, such as milk, beef-tea, chicken broth, and eggs beaten up; and occasionally, according to habit, a little wine or spirit may be given. He should be permitted to drink iced water or iced lemonade as he pleases. He should have a feather-bed, the sheets ought to be of the softest material, and the coverings light; and there should be two beds in the room, in order that the patient may be changed daily. (2) Two competent nurses should be obtained, one to attend the patient by day, the other by night, and these should never *for a moment* lose sight of him. (3) The hair should be cut short. (4) Heat of skin may be relieved by cold-water sponging, and the swelling of the eyelids and other painful parts by the constant application of cold compresses. (5) To relieve itching olive oil may be used, or, what is better, lanolin, or vaseline, which applied as a dressing to the face will facilitate the removal of scabs; and to destroy the disagreeable odour, some kind of deodorant, such as Sanitas powder, should be sprinkled about and over the patient's face and bed. (6) To procure sleep, opium, or some form of alcohol diluted with warm water, may be given. (7) Salivation should not be interfered with, but the mouth should be kept clean, and sedatives avoided during its continuance. (8) When delirium is marked, in addition to the nurse there should be an attendant, one accustomed to deal with lunatics if possible. Mechanical restraint should be avoided, and the 'strait jacket' and 'tying down' strictly forbidden. The patient ought not to be left for one moment alone, otherwise he may have to be looked for wandering along some street, or drowned in the nearest watercourse. He should not be argued with, nor flatly contradicted. If he should imagine his attendants are bent upon injuring or killing him, they should be changed. If he be excited by the mere presence of others, as may happen in hospital wards, he should be treated by himself in a dark room. Should he persist in getting out of bed and putting on his clothes, in walking about his room, or in sitting over the fire, he should be permitted to do so, for to the fretted and fevered patient moving about is a relief. In maniacal delirium chloroform may be administered. (9) The eyes should be carefully watched, and in severe cases an ophthalmic surgeon should be consulted. (10) About the eleventh day laryngitis often supervenes, and for this tracheotomy should be performed when there arises distinct difficulty of breathing. Although in the majority of such cases the patient dies, the relief from suffering is so great that the operation should be performed. (11) When crusts begin to form about the nostrils they should be removed, and generally the patient should be kept in bed until suppuration under the crusts has ceased and the skin is healed. (12) Abscesses should be opened when they appear, and a water-bed should be ordered at the same time. (13) The patient may be discharged safely when the crusts and scales have disappeared, and not less than six baths have been given at intervals of two days. Such is the general treatment of confluent small-pox; in the discrete kind little is needed; in the malignant none is of any avail.

The prophylaxis of small-pox is discussed under VACCINATION.

ALEX. COLLIE.

SMELL, Disorders of.—*See* NOSE, Diseases of; and OLFACTORY NERVE, Morbid Conditions of.

SNAKE-POISONS. — *See* VENOM, Effects of; VENOMOUS ANIMALS.

SNEEZING, Excessive.—SYNON.: Fr. *Coryza Spasmodique*; Ger. *Niesekrampf.*

DEFINITION.—An affection characterised by frequent and uncontrollable attacks of sneezing, out of all proportion to the nasal secretion.

ÆTIOLOGY.—The causes of excessive sneezing may be broadly classified as *extrinsic* and *intrinsic*. *Extrinsic* causes include especially various vegetable substances in the form of powder, of which tobacco-snuff is the type, and the pollen of certain plants (*see* HAY FEVER). The *intrinsic* conditions in connexion with which the affection occurs vary considerably. In some cases it is associated with whooping-cough or asthma, and it is not uncommon in gouty persons. It is sometimes a symptom of the hysterical condition, and not infrequently associated with disordered menstruation, or some other derangement of the sexual functions. It has been met with in pregnancy, and even during more than one pregnancy in the same person, ceasing in the intervals, and has been supposed to replace morning-sickness (Barnes). In some persons a bright light or intense colour is sufficient to determine an attack of sneezing.

SYMPTOMS.—The morbid sneezing has no special characters. It is distinctly a reflex act, being excited usually by some slight impression on the fifth nerve. A slight catarrhal condition of the nasal mucous membrane is common. The secretion has been thought to be, in some cases, of a specific character, analogous to that of hay fever.

TREATMENT.—The attack itself may be usually cut short by a strong impression on some branch of the fifth nerve; when this fails, a mustard poultice to the back of the neck, or an emetic, may be employed. Atomised astringent nasal inhalations, or the vapours of creasote or iodine, are useful, but the most effectual agent is the cautious application to the nasal mucous membrane of a solution of hydrochlorate of cocaine. This is best effected by a fine spray-apparatus, by which at each jet about a drop of a 3 per cent. solution is injected, the patient sniffing at the time. One or two drops may be thus applied to each nostril twice daily, and the treatment is usually most effective. The immersion of the head in cold water has also been recommended. Any irregularity in the functions of the genital or other organs must be attended to; and iron, quinine, and arsenic, if not otherwise objectionable, are useful in removing the liability to the complaint. *See* CATARRH; and HAY FEVER.

W. R. GOWERS.

SNUFFLES.—A popular term for the condition in which a nasal discharge exists in children suffering from congenital syphilis. *See* SYPHILIS.

SODEN, in Taunus, Germany.—Common salt waters. *See* MINERAL WATERS.

SOFTENING.—SYNON.: Fr. *Ramollissement*; Ger. *Erweichung.*—A term of pathological significance, implying that an organ or tissue has a degree of consistence less than that which is natural to it. This is a condition which occurs in various organs or parts (1) as a result of pathological changes *during life*; and (2) as a consequence of different *post-mortem* influences.

(1) **Intra-vitam Softening.**—With regard to the first order of changes, the brain and the spinal cord are the organs in which softening is most common, and in which it is apt to assume its most typical characters (*see* BRAIN, Softening of; and SPINAL CORD, Softening ot). It occurs also in the osseous system (*see* BONE, Diseases of). The liver and spleen may likewise be softer than natural, and so may the mucous membrane of the stomach or intestines, or the tissue of the heart. In nearly all such cases the principal cause of this diminished consistence is a fatty degeneration or infiltration, associated with more or less of serous infiltration (*see* FATTY DEGENERATION). This pathological condition is the reverse of those conditions of induration known by the name of *sclerosis* in some organs, and *cirrhosis* in others. *See* SCLEROSIS.

(2) **Post-mortem Softening.**—The softening due to the definite pathological processes just referred to must be clearly discriminated from certain softenings which may supervene after death as a result of traumatisms or mere *post-mortem* changes. Thus the tissue of the brain or of the spinal cord, in some parts, may be diminished in consistence, and rendered more or less pulpy, owing to its having been bruised during the operations necessary for exposing these organs to view. The same organs likewise diminish in consistence by mere lapse of time after death, and the more quickly in proportion to the heat of the weather. In the stomach also *post-mortem* softenings are most prone to show themselves, should the organ contain gastric juice at the time of death. Here we get softening first, and afterwards solution of the mucous membrane and other tissues of the organ by a kind of digestive process. *See* STOMACH, Diseases of; 19. Softening of.

H. CHARLTON BASTIAN.

SOLIS ICTUS (Lat.)—A synonym for sunstroke. *See* SUNSTROKE.

SOMNAMBULISM. — Sleep-walking. *See* SLEEP, Disorders of.

SOMNILOQUY.—Sleep-talking. *See* SLEEP, Disorders of.

SOMNOLENCE. — An unnatural drowsiness or disposition to sleep. *See* SLEEP, Disorders of.

SONOROUS RALE. — A variety of dry *râle* or rhonchus, of a low-pitched character, resembling snoring and similar sounds, and produced in the larger air-tubes. *See* PHYSICAL EXAMINATION; and RHONCHUS.

SOPOR (Lat.) — An unnatural deep sleep, from which the patient can only be roused with difficulty. *See* CONSCIOUSNESS, Disorders of.

SOPORIFICS (*sopor*, heavy sleep).—SYNON.: Fr. *Soporifiques*; *Soporatives*; Ger. *Einschläfernde Mittel.*—Agents that promote sleep. *See* NARCOTICS.

SORDES (Lat. filth). — DEFINITION.—Crusts which form upon the lips and teeth of persons suffering from extreme exhaustion.

DESCRIPTION.—Sordes occur commonly in what is called the typhoid state, whether this be due to typhoid or puerperal fever, pneumonia, or any like disease. They appear first as thin, light-yellowish crusts upon the prolabia, generally in close proximity to the teeth; gradually increase in thickness and in area; and, changing their colour to brown, or even black, at length extend to the adjacent surfaces of the teeth. They seldom or never cover those portions of the teeth which are hidden by the lips, but spread over their exposed surfaces; so that, as the patient lies with slightly parted lips, they bridge over the interval in the form of a narrow band upon the middle of the incisors of the upper jaw. When the lips are more widely separated, the sordes do not extend, unless in conditions of extreme exhaustion, over the whole of the exposed surfaces of the teeth, but form two ridges, corresponding with the margins of the upper and lower lips.

Sordes are composed of various schizomycetes, mingled with *débris* of food and epithelium. Micrococcus occurs almost constantly; bacillus subtilis frequently; and the writer has found, each in a single instance, sarcina ventriculi and spirochæta plicatilis.

PATHOLOGY AND TREATMENT.—These organisms, which are of constant occurrence on the papillary surface of the healthy tongue, are easily dislodged from the smooth lips and teeth. But in conditions of great prostration, especially when the prostration is associated with delirium, the slight frictions necessary for their removal are not made, and they obtain so firm a hold that they can only be removed by careful and repeated cleansing. Such cleansing may with advantage be performed with a piece of soft rag, or a brush dipped in a weak solution of Condy's fluid.

HENRY T. BUTLIN.

SORE-THROAT. — A popular name for various affections of the pharynx, larynx, and tonsils. *See* LARYNX, Diseases of; PHARYNX, Diseases of; THROAT, Diseases of; and TONSILS, Diseases of.

SOUFFLE (Fr.) — A soft, blowing sound. The term is applied either to the respiratory murmur heard over the lungs; or to certain murmurs heard in connexion with the heart or blood-vessels. *See* PHYSICAL EXAMINATION.

SOULZMATT, in Alsatia.—Alkaline table-waters. *See* MINERAL WATERS.

SPA, in Belgium.—Iron or Chalybeate waters. *See* MINERAL WATERS.

SPAIN, Southern.—*See* MALAGA; and CLIMATE, Treatment of Disease by.

SPANÆMIA (*σπανός*, rare; and *αἷμα*, blood).—A condition of blood, in which the amount of its solid constituents is below the normal, the blood then appearing thin. *See* ANÆMIA; and BLOOD, Morbid Conditions of.

SPAS.—*See* MINERAL WATERS.

SPASM.—SYNON.: Fr. *Spasme*; Ger. *Krampf.*

DEFINITION.—A name given to abnormal contraction, occurring either in muscular organs, in single muscles, or in groups of muscles.

1. *Spasm of muscular organs.*—Concerning spasms of organs not much requires to be said here. We may cite as instances those spasms which occur in the pharynx in hydrophobia; the contractions of the œsophagus in œsophagismus and in some cases of hysteria; the painful contractions of the intestine which are presumed to occur in certain cases of colic; of the lower end of the rectum in tenesmus; of the bladder or of the urethra in certain cases of inflammation with irritability; of the vagina in vaginismus; of the uterus in rare cases of sudden abortion resulting from shock; possibly of the heart in certain diseases of that organ; of the vessels in various regions of the body, and on various occasions, from overaction of vaso-motor nerves; of the bronchial tubes in certain cases of asthma and hay fever; of the glottis in laryngismus stridulus, and in pertussis; as well as of the gall-ducts or ureter under conditions of irritation, either direct or reflex. In reference to many of these conditions the reader may refer to special articles in which they are considered. All are due to excessive nervous stimuli, maintaining conditions of muscular contraction which are unusual both in degree and in duration. These spasms are, therefore, tonic in type, and in almost all the cases cited it is involuntary muscular fibres that are involved.

2. *Spasm of single muscles or of groups of muscles.*—The next class of spasm is that which affects the striped or voluntary muscles. They are divisible into two main categories, that is, into *tonic spasms*, in which the contractions are continuous, and *clonic spasms*, in which contractions and relaxations occur in quick succession; the former being typified by cramps, and the latter by convulsions.

Under *tonic* spasms, we may have cramps of brief duration, affecting a single muscle, such as the diaphragm in hiccough; or of prolonged duration, as in the sternomastoid in certain cases of wry-neck. The tonic contraction may affect several muscles at the same time, as in lock-jaw, or the painful cramps which occasionally occur in the calves of the legs, or in other parts of the body. Such local spasms occur also in the condition known as tetany, in conjugated deviation of the eyes, and in writer's cramp; likewise in spasmodic spinal paralysis, in hysterical paralysis, and under various conditions of irritative organic disease implicating motor nerves, or motor centres or tracts either in the spinal cord or in the brain. More general tonic spasms occur in catalepsy, in tetanus, and in strychnine poisoning.

This whole class of tonic spasms is supposed to be due to irritation, mechanical or chemical (nutritive), operating *directly*, either upon motor centres or upon the fibres conveying motor incitations in some part of their course between the brain and the muscles. In other cases, however, tonic spasms are of *reflex* origin, and the cause of irritation operates in or upon sensory surfaces, nerves, or centres.

Clonic spasms are also of various kinds. They may be limited to single muscles, such as the orbicularis palpebrarum; or they may affect particular groups of muscles, such as those of one side of the face, or the muscles of the lower jaw on both sides, or certain of the abdominal muscles, or some of the foot muscles, as in ankle-clonus. In other cases clonic spasms may be more general, taking the form of unilateral or of bilateral convulsions. The latter also may be irregular or of coördinated type. *See* CONVULSIONS.

Where clonic spasms are much slighter in degree and in range, affecting some muscular fibres and that to a small extent, rather than entire muscles in a more marked manner, we have the production of *tremors*, which may be either fine or coarse, local or general.

Transitional conditions exist, connecting all these various manifestations more or less closely with one another. They constitute, indeed, one great assemblage of related though apparently heterogeneous phenomena, which have mostly received separate consideration under their respective names. Though it is desirable that their fundamental relationship should have been thus briefly pointed out, no practical end would be achieved by dwelling further upon the group as a group, upon the physiological meaning or origin of the several forms of spasm, or on their therapeutic treatment, which will be found described under separate articles. *See* MOTILITY, Disorders of; STRYCHNINE, Poisoning by; TETANY; WRITER'S CRAMP.

H. CHARLTON BASTIAN.

SPASMODIC.—SYNON.: Fr. *Spasmodique*; Ger. *Krampfhaft.*—A descriptive epithet applied or applicable to conditions or diseases in which spasms, and mostly those of the tonic class, are met with as prominent or essential constituents; for example, *spasmodic croup*, *spasmodic asthma*, *spasmodic stricture*. *See* SPASM.

SPECIFIC.—When applied to a disease, the word 'specific' signifies that such disease is produced by a special cause, and has special characters, for example, syphilis and the eruptive fevers. When applied to a remedy, it implies that the substance has a distinct and definite effect in the cure of a certain disease, such as mercury in syphilis, or quinine in ague; or that it acts upon a particular organ, as ergot upon the uterus.

SPECTACLES, Uses of.—*See* STRABISMUS; and VISION, Disorders of.

SPECTROSCOPE IN MEDICINE.

INTRODUCTION.—Defining a prism in optics, as a solid angle bounded by two planes, it may be stated, generally, that a spectroscope consists essentially of a prism and a slit. A diffraction-grating may replace the prism, but for medical purposes no advantage is gained by its use.

According to the kind of spectroscope, other accessories are required; thus, there are two kinds of spectroscope used for medical purposes—*chemical spectroscopes* and *micro-spectroscopes*. In the former the slit is set at one end of a tube, known technically as the collimator, at the other end of which, and having the slit in its focus, is a lens which makes the rays admitted through the slit parallel before entering the prism. The prism refracts and disperses (when they can be dispersed) the rays passing through it, and, if they be rays of white light, they emerge from the second face of the prism as a coloured image of the slit, red at one end, violet at the other, passing from red into orange, yellow, green, blue, and violet. This rainbow band is the continuous spectrum of the light-source. If, on the other hand, a light-source be used containing not compound rays, but those of one colour only—for example, such as are yielded by a colourless flame into which a salt of sodium is introduced—then the rays emerge from the prism as a yellow line, a yellow image of the slit. The prism should be set at the minimum angle of deviation for the sodium line. (For the meaning of this term, and the method of setting the prism, the reader may consult Glazebrook's *Physical Optics*.) The spectrum is then magnified in a telescope, which is a small astronomical refractor, moving round the table of the spectroscope, and capable of being focussed.

In *direct-vision* spectroscopes, to which the micro-spectroscope belongs, a compound prism is used; by this means the slit and the prism can be placed in the same straight tube.

In the *micro-spectroscope*, which is a combination of a microscopic eye-piece and a direct-vision spectroscope, a lens collects the rays. Passing up in the optic axis of the tube of the microscope, they then fall on the slit and are made parallel by another lens placed between the slit and the compound prism. This compound prism is composed generally of three prisms of crown glass and two of flint glass, united to each other by Canada balsam. By such a combination deviation is eliminated, while sufficient dispersion is retained to make the spectrum long enough. A right-angled reflecting prism covers half the slit, so that a second spectrum can be compared with that of the substance beneath the objective of the microscope; a side-stage being adapted to the side of the micro-spectroscope, perforated with a square hole, and provided with spring clips to hold tubes, &c., the light being reflected into the hole by means of a plane mirror suitably mounted. The slit can be widened and narrowed by means of a screw and springs bearing on the jaws of the slit, which should be made to move away from each other equally, as this prevents displacement of the centre of a band or line when the slit is widened.

It is advisable to work with both these instruments; but if one only is desired, then the micro-spectroscope is to be recommended. Useful observations may be made, however, with a pocket spectroscope, procurable at a trifling cost.

DIFFERENT KINDS OF SPECTRA.—When light from various sources is examined with the spectroscope, the appearances observed may be classed under three heads: (1) Spectra consisting of bright lines or striæ; (2) Continuous spectra; (3) Absorption spectra.

(1) *Bright-line spectra* consist of bright lines on a dark background, occurring singly or in groups, placed in the same or different parts of the spectrum. Glowing gases or glowing vapours yield such. Metals of the alkalis and alkaline earths yield such spectra when their combinations are heated in the Bunsen flame; the heavy metals require to be

volatilised at a much higher temperature by means of the electric spark.

Metallic poisons may be detected by their bright-line spectra; and the elements, sodium, potassium, calcium, and others, can be similarly detected in the ashes of calculi, and elsewhere. The late Dr. Bence-Jones, in his study of the 'chemical circulation,' used the spectroscope to determine the rapidity of the distribution of lithium salts to distant parts of the body, such as the crystalline lens and the hip-joint.

(2) *Continuous spectra* are yielded by incandescent solids and fluids. Gas-light, candle-light, the electric and lime lights, incandescent platinum, &c., yield a continuous spectrum—the band of colour referred to above, red, orange, yellow, green, blue, and violet—one colour passing gradually into the next without break.

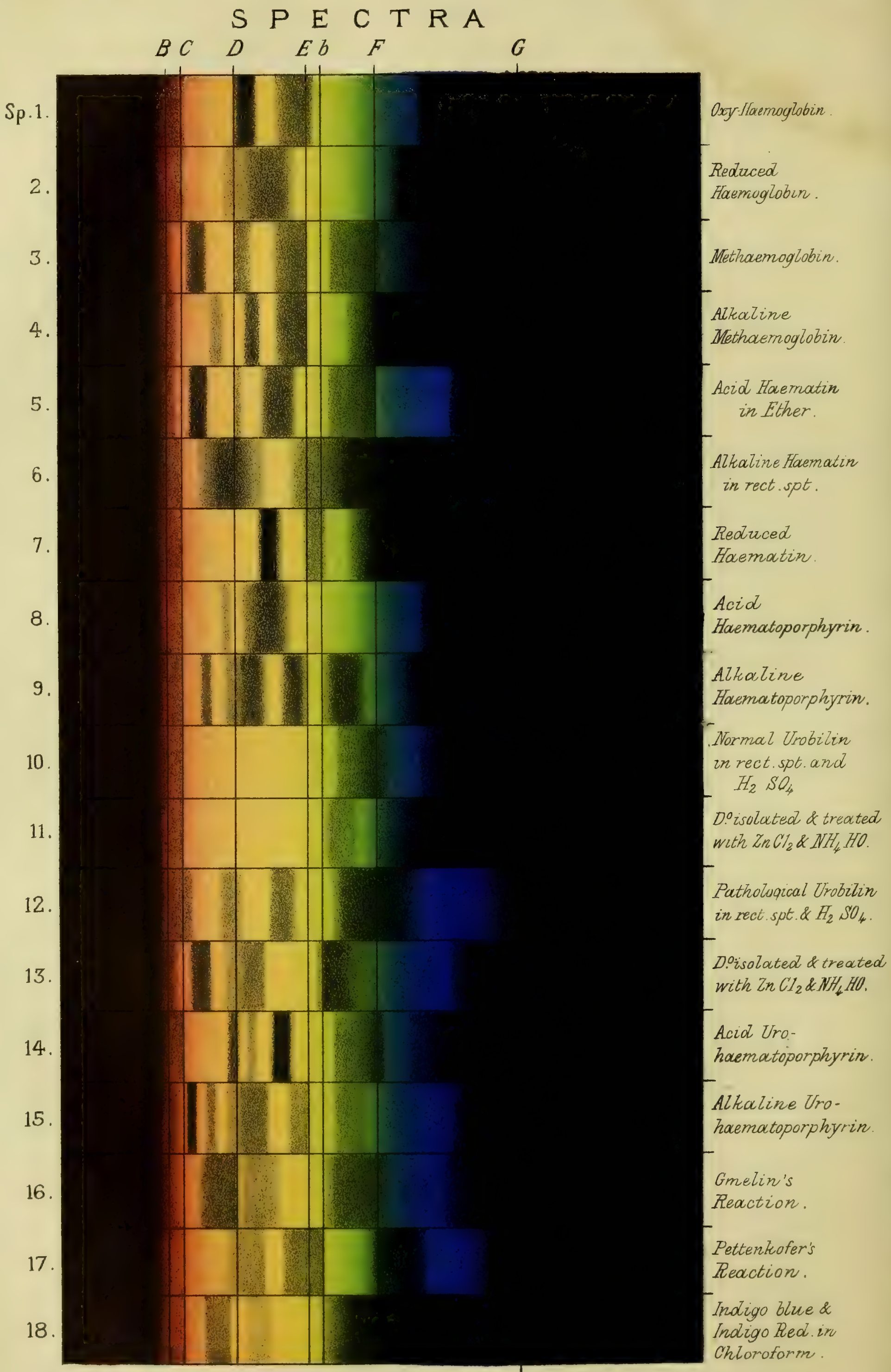
(3) *Absorption spectra* are of two kinds: (*a*) those consisting of black lines occurring in a continuous spectrum; and (*β*) those consisting of broad black spaces, or shadings of varying degrees of darkness, in a continuous spectrum. The spectrum of the sun, and of of many of the stars, are examples of the former, and the latter are those with which medical spectroscopy has to do. These black lines, bands, or shadings are spaces of darkness in the spectrum due to the absence certain rays. Those in the solar spectrum, which were discovered by, and named after, Fraunhofer, are caused by the presence of vapour in the sun's atmosphere. Every gas and every vapour when in a comparatively cool state absorbs the same rays that it emits in the incandescent state. If no vapour existed around the sun, then we should have thousands of bright lines belonging to the elements burning in the sun. Some of the solar lines are, however, telluric, *i.e.* of earthly origin, and are due to absorption in the earth's atmosphere. The most prominent Fraunhofer lines, beginning from the red end of the spectrum, have been called A, a, B, C, D, E, b, F, G, and H.

Solutions of animal and vegetable colouring-matters have the property of arresting certain rays of light passing through them; and corresponding to the rays stopped, or enfeebled, we have spaces of darkness in the spectrum—the *absorption bands*. Solid pigments may do the same, even when the light analysed (by the prism) is reflected from their surface. Absorption may, however, be general, that is, one or the other end of the spectrum may be absorbed.

The Study of Absorption Spectra.—Two pigments may give the same spectrum, and yet not be identical; to prove identity, their respective spectra must be changed in the same way by reagents. In studying such spectra, the first thing to be done is to map the principal lines in the solar spectrum. By consulting a map of the solar spectrum, and then examining the spectrum of diffused daylight, concentrated, if necessary, by a condenser on the slit, it is easy to identify the most prominent Fraunhofer lines referred to above. Of these A, a, and H are not easy to see. Next they should be mapped on a piece of smooth drawing-paper. Both the chemical spectroscope and the micro-spectroscope should be provided with *photographed scales*; angular measurements for the former are only indispensable for certain measurements, such as the calculation of refractive indices. These scales can in both instruments be illuminated by a mirror at the end of the scale-tube. By means of a millimetre scale a map is easily made from the readings obtained from the Fraunhofer lines. The scale of this instrument is to be set so that D shall stand at a convenient number; for the chemical spectroscope it is generally set at 50.

In mapping an absorption spectrum we begin by setting the scale. A flame coloured by a sodium salt is brought before the slit of the chemical spectroscope, or reflected up by means of the microscope mirror on to the slit of the micro-spectroscope; then the scale is adjusted until the sodium line stands at the same number on the scale that the D line stood at. The slit is then illuminated by means of artificial light, say an Argand gas-burner, the light being condensed on the slit by a bull's-eye condenser in the case of the chemical spectroscope. The fluid to be examined is then placed in a vessel, such as a test-tube, held in a suitable holder, before the slit of the chemical spectroscope, or in a small flat-bottomed tube let into a thin slab of wood, for the micro-spectroscope. If the solution be too darkly coloured to transmit the spectrum, either a thinner layer or a more dilute solution must be used. Hermann's hæmatoscope is frequently used for this purpose, as by means of a screw-adjustment any depth of fluid can be examined; it is only applicable to the chemical spectroscope. The slit must not be too wide, and the focus should not be altered after the sodium line has once been focussed. A black cloth, to exclude extraneous light, should be used to cover the chemical spectroscope. Bands in the red end of the spectrum are best seen by artificial light, in the violet by daylight. For examining portions of organs or tissues a compressorium is very useful, as various degrees of thickness can then be examined.

When publishing results, it is necessary to give the measurements of absorption bands in terms of a universal scale. Now, no two arbitrary scales agree, so that all measurements should be reduced to wave-lengths, denoted by the sign λλ. Zeiss's micro-spectroscope is provided with a wave-length scale, but the readings of any spectroscope may be reduced to wave-lengths by means of an *interpolation curve*. A sheet of logarithm paper has the arbitrary number of the scale


SPECTRA
B C D E b F G
Sp. 1. Oxy-Haemoglobin.
2. Reduced Haemoglobin.
3. Methaemoglobin.
4. Alkaline Methaemoglobin.
5. Acid Haematin in Ether.
6. Alkaline Haematin in rect. spt.
7. Reduced Haematin.
8. Acid Haematoporphyrin.
9. Alkaline Haematoporphyrin.
10. Normal Urobilin in rect. spt. and H_2SO_4
11. D° isolated & treated with $ZnCl_2$ & NH_4HO.
12. Pathological Urobilin in rect. spt. & H_2SO_4.
13. D° isolated & treated with $ZnCl_2$ & NH_4HO.
14. Acid Uro-haematoporphyrin.
15. Alkaline Uro-haematoporphyrin.
16. Gmelin's Reaction.
17. Pettenkofer's Reaction.
18. Indigo blue & Indigo Red in Chloroform.

C. A. Mac Munn del. M & N. Hanhart lith.

Fig. 138.—Diagram representing the most important Spectra of Pigments.

of the spectroscope written out along the top line, each tenth of an inch corresponding to one division of the scale. Along the side-line, at right angles to this, the wave-lengths are written, each tenth of an inch here being made to correspond to two millionths of a millimetre. It is convenient to begin at the top of this line with 410 millionths of a millimetre, then the next *inch* division has 430 placed opposite to it, and so on down to 730. On referring to Angström's numbers, the wave-lengths of the principal Fraunhofer lines are found to be as follows in millionths of a millimetre: A = 760, a = 718, B = 686, C = 656, D = 589, E = 526, b = 516, F = 486, G = 430. Their value on the arbitrary scale of our spectroscope has been determined by actual measurement. By means of these data their positions on the paper are denoted by small crosses; through the centres of these crosses a curve is drawn. When now we want to know the value in λλ of any number of the scale of the spectroscope, we can find it by running the eye along the perpendicular line joining the top line with the curve, thence to the right-hand side line, where its wave-length is given. In other words, the abscissæ are the arbitrary numbers of the scale, the ordinates the wave-lengths.[1]

Uses of the Spectroscope in Medicine. It is not necessary to describe in detail the various pigments and their spectra which have been discovered in the animal body. It will suffice to point out briefly some of the applications of the spectroscope to medicine, especially as a full account of most of these pigments is given in Professor McKendrick's *Text-book of Physiology*, vol. i., and in Professor Halliburton's *Text-book of Chemical Physiology and Pathology*.

In medical jurisprudence the spectroscope is indispensable for the detection of blood-stains on clothing, knife-blades, &c. In poisoning by carbonic oxide from the inhalation of coal gas, charcoal fumes, &c., the spectrum of the blood is peculiar, and reduction, by means of sulphide of ammonium, cannot be brought about. Other poisonous gases have been found to enter into peculiar combinations with hæmoglobin, such as nitric oxide, &c.; doubtless research will reveal the existence of many such combinations.

To the physician the instrument is useful in enabling him to detect blood and its decomposition-products, and also bile-pigments and their decomposition-products, in urine and various pathological fluids, under diseased conditions, and from the administration of drugs. In the detection of various pigments, which cannot be recognised by other methods, microscopic or chemical, as well as in enabling us to form an idea as to the extent and nature of the metabolic changes taking place under the influence of disease, the spectroscope promises to be a helpful guide. In fact, pigments have already been found in the urine which can be produced artificially from hæmoglobin and hæmatin, &c., by certain chemical methods, by means of which we have found out how they are produced in the body. These pigments serve as finger-posts to point out the various steps of the abnormal processes by which not only they, but the substances with which they are associated, are originated. The pigment known as urohæmatoporphyrin may be given as an example. This can only be produced in the laboratory by the action of very energetic *reducing* agents on hæmoglobin or hæmatin, yet it occurs in many diseased conditions, in which, until recently, it was supposed increased oxidation took place; but we now know that exactly the opposite occurs, and the spectroscope confirms this. Again, the rapidity of the reduction of oxyhæmoglobin to reduced hæmoglobin may be measured by the spectroscope, as Hénocque has shown. Observing the ungual phalanx of the thumb, at the root of the nail, by means of a direct-vision spectroscope, he finds, if a ligature be quickly applied, that in health reduction takes place in seventy seconds, whereas in anæmic states it may happen in from thirty to forty seconds, being dependent on the amount of hæmoglobin, the amount of hæmoglobin reduced in one second being 0·2 per cent. under normal conditions.

Wertheimer has also made use of the spectroscope in a novel and ingenious manner. He injected sheep-bile into the femoral and mesenteric veins of dogs, and detected the presence of the writer's cholohæmatin in the bile of the dog within ten minutes after its injection into the femoral, and five after its injection into a mesenteric vein, showing, as he remarks, that the liver has the power of picking the constituents of bile out of the circulating blood.

Instead of repeating what is already known about the pigments and their spectra, attention is called to the accompanying chart (fig. 138), where the most important spectra are figured. In this, sp. 1 represents the spectrum of oxyhæmoglobin. That of the compounds of carbonic oxide and of nitric oxide, respectively, with hæmoglobin resembles this, except that the bands are nearer the violet. 2 is the spectrum of reduced hæmoglobin, got by adding sulphide of ammonium to a solution of oxyhæmoglobin. 3 is the spectrum of methæmoglobin, a substance intermediate between hæmoglobin and hæmatin, in which the oxygen is more firmly combined than in oxyhæmoglobin. It occurs on the edges of healing wounds, in old blood-stains, in various exudations, &c., and may be produced artificially by treating a solution of blood with a great number of reagents, which are not energetic enough to split the hæmoglobin into hæmatin and a proteid. 4 is the spectrum of alkaline methæmoglobin, *which is very often mistaken for oxyhæmoglobin in alkaline urine.* It may be obtained by adding a little ammonia to a solution of methæmoglobin. 5 is the spectrum of acid hæmatin in ether; and 6, that of alkaline hæmatin in rectified spirit. 7 is that of reduced hæmatin, got by adding a reducing agent, such as ammonium sulphide, to a solution of alkaline hæmatin. Hæmochromogen is another name for this pigment. This is a very important spectrum, as by its means blood can be detected with great certainty when present in minute traces. Sometimes blood may be present in urine, adhering to the sediment; if this be filtered off, digested in rectified spirit containing ammonia, filtered, and the filtrate treated with ammonium sulphide, this spectrum is obtained. Again, in detecting blood-stains on clothing, knife-blades, &c., the bit of cloth, or blade, is treated with the same reagents, with a similar result. 8 is the spectrum of acid hæmatoporphyrin, got by dissolving hæmoglobin in strong sulphuric acid and filtering through asbestos; and 9, that of alkaline hæmatoporphyrin, obtained by dissolving hæmatoporphyrin in alcohol and ammonia. These two spectra, and 14 and 15, should be carefully studied, as a condition known as hæmatoporphyrinuria has lately been described, first by the writer, since then by others. In many of these cases it seems to have been caused by the administration of sulphonal, but not in all. The urine is a deep Burgundy-red colour, and decomposes very slowly; a specimen obtained in May 1890 still remains unchanged. 10 is the spectrum of normal, and 12 that of pathological, urobilin, in rectified spirit and sulphuric acid; that of stercobilin is almost identical with the latter. 11 and 13 are the spectra of normal and pathological urobilin respectively, treated in a spirit solution with zinc chloride and ammonia, which develops a green fluorescence. 14 and 15 are the spectra of acid and alkaline urohæmatoporphyrin. This pigment can be obtained by treating hæmatin with energetic reducing agents, aided by heat, such as sodium amalgam, zinc and sulphuric acid, &c.; at an early stage hæmatoporphyrin is produced, then this pigment. It occurs as such, as the writer has discovered, in the urine of acute rheumatism, and of many other diseases, including Addison's disease. Dr. A. E. Garrod finds that its presence is independent of blood-destruction in rheumatism, and must probably depend upon a failure of those organs, in which it should be metabolised to other pigments, to effect such change.

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[1] By using the *reciprocals* of the numbers expressing the wave-lengths, the curve becomes nearly a straight line. The reciprocal of a fraction is obtained by making the numerator and the denominator change places. Thus, the reciprocal of $\frac{1}{2}$ is $\frac{2}{1}$, the reciprocal of 5 is $\frac{1}{5}$, and of $\frac{1}{5}$ is $\frac{5}{1}$, *i.e.* 5.

Bilirubin[1] and biliverdin, the colouring-matters of human bile, give only a *general* absorption of the spectrum; but either of them when treated with nitric acid gives 16, that of Gmelin's reaction, when the spectrum of the violet stage is examined. 17 is the spectrum of Pettenkofer's reaction; and 18, that of indigo-blue and indigo-red from *normal* urine, by heating with hydrochloric acid to which a little nitric acid has been added, then, when cold, agitating with chloroform. This test succeeds when Jaffe's fails.

The above are the most important spectra from a purely medical point of view. There are, of course, other pigments in the human body present under normal conditions, such as myohæmatin and the histohæmatins (discovered by the writer), the lipochromes or fat-pigments, formerly known as luteins, and the black pigments included under the name of melanines. The last show no absorption bands, and probably arise somehow in connexion with the lipochromes, although in cases of melanuria associated with melanotic sarcomata a chromogen, or colourless mother-substance, is present which on oxidation changes into melanin. At all events, the origin of a melanin from hæmoglobin seems doubtful.

Many attempts have been made to explain the bronzing of the skin in Addison's disease, but as yet physiologists are not disposed to accept any of the hypotheses offered. The writer finds, however, that the suprarenal bodies of many mammals contain hæmochromogen, pointing to the indisputable fact that these organs are concerned in the downward metabolism of effete hæmoglobin; this, taken in connexion with the presence of urohæmatoporphyrin in the urine, would seem to point out that, if the suprarenal bodies are diseased, then effete blood-colouring matter must be present in excess in the blood, and produce staining of skin and mucous membranes.

Charles A. Mac Munn.

SPECULUM (Lat.)—Synon.: Fr. *Speculum*; *Miroir*; Ger. *Speculum*; *Spiegel.*

Definition.—An instrument adapted for exploring the several channels and deeper-seated parts of the human body. The chief of these are the ear, the eye, the nose, the mouth, the throat, the rectum, and the vagina. For each of these there are specially adapted instruments.

Description.—Specula are made of various materials, and in a variety of shapes. The speculum is intended not only to permit and facilitate inspection, but also to dilate the canals and to expose parts, in order that they may be treated surgically, or have medicaments applied to them. For this reason a cylindrical speculum will not always answer the purpose; we have, therefore, bivalve and trivalve specula, and many other forms. On account of the friability of glass, other material has not infrequently to be used, such as white polished metal, celluloid, or wood; the latter is objectionable, as it has no reflecting power; but when it becomes necessary to apply the actual cautery through a speculum, a substance must be employed that is a non-conductor of heat and non-friable, such as wood.

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[1] Which is identical with hæmatoidin.

VARIETIES.—**Aural specula.**—Of these there are several forms, and some are known under the name of 'auriscopes.' Some have a trumpet-shaped opening, which facilitates the introduction of light, and greatly increases the illuminating and reflecting power. There are also bivalve aural specula with a screw lever, and others with handles attached so as to separate the blades.

Eye specula.—These are known by the name of *eyelid retractors* and *ophthalmoscopes*, both of which are really specula for examining the eye, though not generally classified as such. *See* OPHTHALMOSCOPE.

Nasal specula.—There are several forms of these, the great purpose they have to serve being that of dilating. One, known as Elsberg's, is three-bladed.

Throat specula.—Specula for examination of the throat are generally called *laryngoscopes*. *See* LARYNGOSCOPE.

Rectal specula.—These are cylindrical, bivalve, or trivalve. The cylindrical are made on the principle of Fergusson's vaginal speculum, but with an opening so as to expose the wall of the rectum at the part to which it is adapted. The valvular forms are made of white metal.

Vaginal specula.—Of these there are many kinds. Perhaps the most useful is that known as Fergusson's, which is cylindrical and made of glass, with a coating of mercury behind it, so as to give it reflecting power, and backed by vulcanised indiarubber. An improved variety of this is of a tapering form, so as to admit more light. *See* WOMB, Diseases of.

Sims's duckbill speculum is of great use in retracting the perinæum and dilating the vagina, when space is required for operation, as in vesico-vaginal fistula. Then there are bivalve and trivalve metallic specula. Wooden cylindrical specula are always used when the actual cautery is applied, for reasons already mentioned. For the ordinary purposes glass is the preferable material, as it is unaffected by caustics.

The uses of specula will be found described in connexion with the diseases of the several organs to which they have reference.

It is worthy of record that many varieties of specula have been discovered among the ruins of Pompeii, and that recently a quadrivalve vaginal speculum has been unearthed there. CLEMENT GODSON.

SPEECH, Disorders of.—SYNON.: *Troubles du Langage*; Ger. *Stöhrungen der Sprache.*—Defects of speech are very various in their nature, degree, and mode of causation. They are capable of being classified from several different points of view. The writer will not attempt to do more in the present article than point out the nature and relations of the several kinds of defects, which will, in almost all cases, be found to have received consideration under their own proper headings.

ÆTIOLOGY AND PATHOLOGY.—Disorders of speech may depend upon (1) *congenital*, or (2) *acquired* defects of the brain, or of certain of its nerves and sense-organs.

1. *Congenital defects.*—The most frequent and important of these defects is *deafness*, which entails mutism, so that the individuals thus afflicted are known as 'deaf-mutes.' It must, however, be borne in mind that this condition of mutism or dumbness may also be brought about by absolute deafness occurring from any cause after birth, but before the child begins to talk; or even after it has learned to talk, up to the fifth or seventh year. In cases of the latter type, the child, when without the accustomed guidance derived through the sense of hearing, soon forgets how to speak and becomes dumb. In addition to this class of cases, there are those of congenital idiocy without deafness, but in which the child never learns to talk or articulate in the proper sense of the term (*see* IDIOCY). There are also other cases allied to the last, in which, owing to some intracranial lesion occurring either before, during, or soon after birth, the child's subsequent mental condition is greatly impaired, as well as its motor power. In these most deplorable cases the child may never be able to speak in any distinct or articulate fashion, it may not be able to walk or even stand, or it may only be able to accomplish these latter acts imperfectly. In some of these children there is evidence of the existence of a hemiplegic condition, with arrest of growth of the paralysed limbs. Such patients are also frequently subject to one-sided fits; but it is not certain whether in these cases the inability to speak is especially prone to occur in those who are congenitally paralysed on the right side. In some of the less severe examples of this latter type which have come under the writer's observation, speech has been merely deferred—the child has not commenced to speak till the fourth, fifth, or even the sixth year. *See* DUMBNESS.

During the last two or three years the late Dr. Hadden has described several curious cases of speech-defect met with in children, to which the term 'idioglossia' has been applied. These persons have to a certain extent a language of their own; so that when asked to repeat phrases, they make use of sounds of their own instead of those proper to the words that should be employed. The sounds which they substitute are said to be always the same for the same words, though some of these patients at least seem to be capable of writing correctly from dictation. They may also show a fair amount of intelligence generally.

2. *Acquired defects.*—Among acquired defects of speech we have troubles of various degrees and kinds, which may come on at any period between infancy and old age, and which, as regards duration, may be temporary or permanent. The great variation in the extent and nature of these defects is due to the fact that the impeding condition or lesion may act (1) upon parts of the brain concerned with the genesis of thought, and of the will to speak; (2) upon some part of the nervous channels or centres concerned with the actuation of speech; or (3) upon the peripheral nerves and organs concerned with articulation and vocalisation. Thus it happens that acquired defects of speech may, in one set of cases, be associated with the most marked alterations in the intelligence or previous mental condition of the patient, whilst in others they may be represented by mere defective articulation or vocalisation. In briefly referring to the principal varieties, it will be convenient to pass from the simple to the more complex types.

Proper vocalisation is essential for the production of normal speech; where it alone is defective we have to do with various kinds of aphonia, which may be due to very different causes (*see* VOICE, Disorders of). Again, articulation as a mere motor act may be interfered with or perverted in diverse modes. Where speech-movements are incoördinate, we have such common defects as stuttering or stammering (*see* STAMMERING); or else those less marked perversions of speech-movements which are met with in some cases of chorea. Again, where the movements concerned in speech are more simply defective, we have that indistinctness of articulation and blurred utterance which, in various degrees, is so commonly associated with different forms of paralysis due to cerebral disease. To this kind of defect the name 'Aphemia' is now commonly applied. It presents itself under many various conditions, and with different degrees of completeness. It may show itself in its most extreme form in 'labio-glosso-laryngeal paralysis,' or in other forms of bulbar disease. This blurred or difficult articulation is also one of the signs met with in general paralysis of the insane, and in disseminated cerebro-spinal sclerosis. Again, it occurs in association with hemiplegia caused by different lesions in various parts of the brain, between the bulb below and the cerebral cortex above. As a rule, it is most marked and most persistent in hemiplegia due to disease of the pons Varolii, while in lesions higher up it is apt to be slight and more transitory, especially where such lesions exist on the right side of the brain. It is evident, indeed, that this kind of defect is specially prone to occur where there is damage to the first parts of the outgoing tract leading from the kinæsthetic centres in the left third frontal convolution, or in any lower parts of the same tract, or when there is damage to the actual motor centres for articulation situated in the bulb. Damage to the third left frontal convolution itself gives rise to a form of speech-defect which is commonly known as *aphasia* (*see* APHASIA). The writer has shown, however, that this condition may, in reality, and in full accordance with modern doctrines as to the strict localisation of cerebral functions, be induced by damage in parts of the cortex comparatively remote from the 'third frontal convolution.' Such forms of speech-defect may exist without any very obvious mental impairment, and it is worthy of note that they may sometimes be induced, without coincident hemiplegia, as a result of over-work, either literary or clerical, or under the influence of great excitement. Related to speech-disorders of this type are the other more complex and extremely varied defects of speech classed under the head of *amnesia.* These are often associated with grave mental and volitional defects. The writer long ago pointed out that they are especially apt to occur in association with lesions involving the convolutions which bound the posterior extremity of the 'Sylvian fissure.' These are parts of the cortex which both clinical and experimental investigations have shown to have much to do with visual and auditory impressions. They would accordingly be concerned with the appreciation, on the one hand, of printed and written characters, and, on the other, of spoken words; and seeing that such parts of the cortex must also afford the starting-points for volitional incitations to acts of writing, reading, and speaking, it can easily be understood how much damage to the brain in these regions may interfere with intellectual 'appreciation,' as well as with intellectual 'expression.'

Finally, in this relation, reference should be made to certain forms of speechlessness occasionally met with in hysterical females, or in the insane of both sexes, in which there may be a deficiency of will to speak, dependent upon perverted cerebral action, either without or with a discoverable basis of actual morbid changes. In such cases patients may remain dumb for months or for years; there may be no apparent motive, or the speechless condition may, in the insane, stand in direct or indirect relation to certain delusions.

PROGNOSIS AND TREATMENT.—The treatment of these various defects of speech will, of course, depend upon their nature, causes, and associated conditions. Reference must, therefore, be made to the several special articles in which the different forms of such defects are considered. It may be said here, however, that most of the forms of speech-disorder dependent upon congenital defects are comparatively little amenable to treatment. Those due to brain-lesions occurring later in life are oftener mere temporary defects, diminishing after longer or shorter periods, as the effects of the original lesions become lessened by time and treatment. Some of the marked cases of aphemia, moreover, are capable of being cured or greatly improved by careful daily drilling in the articulation of vowel-sounds and short words, provided this exercise be persistently and methodically carried out.

H. Charlton Bastian.

SPERMATORRHŒA (σπέρμα, seed; and ρέω, I flow).—Synon.: Fr. *Spermatorrhée*; Ger. *Samenfluss.*

Definition.—A real or apparent discharge of seminal fluid, occurring without voluntary sexual excitement.

Two varieties may be recognised: (1) *True spermatorrhœa* is the discharge of spermatozoa from the urethra, or in the urine, at periods other than during sexual excitement. (2) *False spermatorrhœa* or *prostatorrhœa*, is the discharge of a seminal-like fluid, destitute of spermatozoa.

Ætiology.—Local irritation, whether from masturbation or from some diseased or disordered condition of the genital organs, is the cause of spermatorrhœa in the first instance. General or local morbid conditions, such as balanitis, phimosis, a long prepuce, urethral catarrh, irritability of the prostate, a tender spot in the urethra, varicocele, spasmodic contraction of the levator ani from rectal irritation, worms in the intestinal canal, constipation, and changes in the nerves or nerve-centres supplying the genito-urinary tract, inducing either hyperæsthesia or anæsthesia, serve as excitants. Any of these states may give rise to masturbation, or masturbation may in turn cause most of them. Should the conditions that determine the irritation persist, the very smallest mental or local stimulus is sufficient to continue the disease indefinitely.

Symptoms.—The first symptom that alarms the subject of spermatorrhœa is the occurrence of frequent nocturnal emissions, at first with, and afterwards without, erotic sensation. These reduce his strength, render him weak and irritable, and gradually prey upon his mind; and if, as frequently happens, masturbation be practised, they induce a condition of extreme mental depression. When the patient reaches this state, the mere reference to sexual matters, the sight of anything lewd, the act of defæcation, or a chance irritation of the penis during walking, riding, or driving, is often sufficient to cause an abortive or, it may be, a complete emission. The discharge may, in advanced cases, find its way into the bladder and be passed with the urine; a condition which is regarded by the patient as the most serious of all. The discharge may be the ordinary seminal fluid; or it may be less in quantity, clearer, tenacious, more like synovial fluid in appearance and consistence. In the latter case it seldom contains spermatozoa, but it is usually only the forerunner of the other more serious state, or it may intermit with it. These conditions combine to render the patient for the time being physically and mentally a wreck, sleepless, listless, nervous, anæmic, and with an old and insipidly anxious look upon his muddy or pimpled face. Intercourse becomes well-nigh impracticable, the discharge of semen occurring before the introduction of the organ; or erection may be impossible or imperfect.

Diagnosis.—In the diagnosis of the cause of spermatorrhœa, the condition of the external genitals must first be determined. The presence of a tender spot in the urethra, or the existence of hyperæsthesia or anæsthesia or stricture, can be made out by passing a catheter. The acorn-pointed bougie is the best for diagnosing the exact seat of such troubles. The discharge itself must be found and examined microscopically, the presence of spermatozoa establishing true spermatorrhœa. Glairy fluids, like that of prostatorrhœa, occur in the urethra during the last stages of a gleet, or in straining at stool, and also in stricture. The history of the case, and catheterism, readily clear up the cause of the discharge.

Prognosis.—In the generality of instances the patient gets quite well, either by ordinary care on his own part, or by medical treatment. In other cases, however, the development of some inherited disease manifests itself simply from the weak condition to which the patient is reduced. In some instances dementia or melancholia is induced, and the patient continues his impure habits even whilst under watch and ward in a lunatic asylum.

Treatment.—Should any local irritation appear sufficient to cause spermatorrhœa, it ought to be treated and removed if possible. A long prepuce should be cut off, balanitis cured, a varicocele relieved, or rectal irritation removed. To prevent masturbation many plans have been tried, such as the application of iodine to the penis, or touching the parts with caustics, which, by the pain they cause, prevent the patient meddling with the organ. These measures, or such as these, combined with encouragement from the medical attendant, and resolution on the part of the patient, will help towards a cure. The situation of a tender spot in the urethra can be made out by a bougie—the acorn-pointed bougie being the best, or by pressure on the perinæum; or it may be possible to see a local change by the urethroscope. When discovered, the tenderness may be relieved by counter-irritation to the perinæum, or by applying caustics directly to the tender surface, either in substance or in solution. The solution chiefly used is one of nitrate of silver, varying in strength from five to sixty grains to the ounce, and it is best applied by the silver syringe-catheter, the flexible tube, or through the urethroscope. The patient's digestion and impaired physical and mental condition must be looked after. Stomachic and nervine tonics, such as gentian, strychnine, phosphates, and iron, are the most useful, and must be given for some time. To allay irritability of the genital organs, the bromides and belladonna may be given, separately or in combination. For hyperæsthesia the extract of belladonna, in half-grain doses morning and evening, is especially useful; it may be given with the tonics recommended above. Should anæsthesia of the urethra and genitals exist, galvanism has been tried and has proved successful. The patient should sleep on a hard bed, and get up the moment he wakes. A separate bedroom should be disallowed. Cold hip-baths morning and evening, rectal injections of cold water, walking exercise, and mixing in company as much as possible, are useful adjuvants to treatment. Various mechanical contrivances have been suggested, but attention to the moral and physical health will do much to allay nocturnal emissions. *See* MASTURBATION.

JAMES CANTLIE.

SPEZIA, Bay of, in Central Italy. A calm, moist, moderately warm, equable winter climate. Mean winter temperature, 50° F. *See* CLIMATE, Treatment of Disease by.

SPHACELUS (σφάζω, I destroy).—The process of mortification; or, more correctly, the dead mass resulting from this process. *See* GANGRENE.

SPHINCTERS, Disorders of.—SYNON.: Fr. *Troubles des Sphincters*; Ger. *Stöhrungen der Schliessmuskeln.*

From a practical point of view, it is here only needful to refer to disordered actions of the sphincters of the bladder and of the rectum. The disorders themselves are in each case of two kinds. We may have to do with *spasm* of the sphincter vesicæ or of the sphincter ani, leading to or, at least, aiding in bringing about, retention of urine and retention of fæces respectively; or, on the other hand, there may be *paralysis* of these sphincters, leading to incontinence of urine, and favouring incontinence of fæces.

ÆTIOLOGY AND PATHOLOGY.—These opposite modes of disordered function of the sphincters of the bladder and the rectum may be variously induced; but the causes may be ranged in three principal categories, according as they are—(1) of *peripheral* or *reflex*, (2) of *spinal*, or (3) of *cerebral* origin.

1. *Peripheral causes.*—These are not always distinct from those of the next category, and they more frequently reveal themselves as spasms than as paralyses, except when the cause is some actual inflammatory disease (peripheral neuritis) involving the nerves which supply the sphincters. Retention of urine due to reflex spasm of the sphincter of the bladder is frequent enough, especially in stricture of the urethra or stone in the bladder. On the other hand, a weak action of the sphincter, with undue irritability of the bladder, may lead to nocturnal incontinence of urine in children. Temporary paralysis of both sphincters may occasionally be induced by a kind of cerebral reflex, under the influence of fright. Spasmodic conditions of the sphincter ani may be induced by the irritation of fissures or small ulcers just within the anus, and may tend greatly to increase the suffering of the patient during or after defæcation.

2. *Spinal causes.*—The majority of the cases of disordered action of the sphincters will be due to this class of causes. They are incidents of functional or of structural diseases of the spinal cord, acting upon the nerves by which such sphincters are supplied. Here, too, we may have irritation of the spinal centres, causing spasms and corresponding retention of urine or of fæces; or we may have pressure upon or destructive lesions of the same parts, in the lower lumbar region of the cord, leading to paralysis of the sphincters, and a corresponding incontinence of urine or of fæces. Irritation or destruction of the channels in the cord, by which voluntary incitations are conducted to these lumbar centres, may also lead to spasm or paralysis of either of the sphincters (*see* SPINAL CORD, Diseases of). In many structural diseases of the cord entailing paraplegia, paralysis of the sphincters (owing to its different sequelæ) becomes an important condition, which notably influences the gravity of the disease, and demands the exercise of great care in counteracting its effects, as far as this may be possible. *See* SPINAL CORD, Special Diseases of: 9. Softening of.

3. *Cerebral causes.*—In cerebral disease, where the mind or consciousness is profoundly affected, there may be incontinence of fæces or of urine. Yet such events can scarcely be said to be due to a disordered action of the sphincters. If no restraining or inhibitive power be exercised by the cerebral hemispheres, then the spinal reflex mechanisms regulating the action of the detrusor muscles and of their related sphincters are called into play from time to time. The latter become relaxed coincidently with the contrac-

tion of the expulsor muscles of the bladder or rectum, when, from either viscus, a sufficiently powerful set of afferent impressions passes to the related spinal centre. So that in hemiplegia with mental impairment, in dementia, or in stupor or coma, we commonly meet with incontinence of urine and of fæces. Over-action or spasm of these sphincter muscles may also occur under various perverted cerebral conditions, especially in hysteria; thus occasioning an undue retention of the contents of the bladder or of the rectum, as the case may be.

The sphincter of the vagina is also liable to be affected by spasm, but this subject is considered in another part of this work. *See* VAGINA, Diseases of.

TREATMENT.—The treatment of disorders of the sphincters must of course depend upon the nature of the cause, and upon the nature of the particular defect existing in each individual case. When the exciting cause is local, it must be remedied if possible. Where due to structural disease in the spinal cord or in the brain, the above disorders present themselves among many other morbid signs and symptoms; and in these cases we must always strive to correct, as far as it may be possible, the original and common cause of the morbid symptoms in question.

H. CHARLTON BASTIAN.

SPHYGMOGRAPH, The (*σφυγμός*, the pulse; and *γράφω*, I write).

DEFINITION.—The pulse-writer; an instrument devised to record the form of the movements of the arterial pulse.

HISTORY.—The idea of this instrument is as old as Galileo, but it is only in recent years that it has assumed a practical form. The first registering instrument, for recording the movements of an artery, was used by Ludwig in 1847, ten years after Hérisson had devised his sphygmometer, by which he showed in a column of fluid the movements of the pulse. It was with this instrument that Chelius demonstrated the second wave, or dicrotism, of the normal pulse.

Vierordt was the first to construct a sphygmograph which could be applied on man, utilising an idea of King's, who had previously demonstrated the pulsation of the veins in the neck by attaching to them a delicate lever. The instrument of Vierordt, however, did not record the form of the pulse-movements accurately, and for the most part registered only a series of uniform curves. This physiologist remarked that the problem was to place on the pulse a very delicate elastic spring, and by means of it to transmit the movements of the pulse to the writing lever. Marey succeeded in doing this by the invention of his sphygmograph, which became, after the publication of his work in 1863, forthwith applicable for clinical, as well as physiological, research. Its introduction gave the study of the pulse a scientific basis, by causing the arteries to write their autographs, and thereby restored to its first importance the neglected art of reading the pulse.

DESCRIPTION.—Although there are now several sphygmographs at work in the field of clinical inquiry (Marey's, Pond's, Dudgeon's), it will be necessary to describe only that of Marey, which is most commonly in use.

The essential part of the instrument is a delicate spring, armed at its free end with an ivory pad which rests upon the artery. The spring is fixed by its other extremity to the frame-work, and receives the pulse-movements, which are transmitted, amplified, and recorded by an arrangement of two levers. The lower lever is hinged to the steel spring, so that it can move up and down at its free end, which terminates in a vertical knife-edge considerably above the ivory pad which rests on the artery. This knife-edge can be raised or lowered by means of a screw, and so adjusted and maintained in contact with the upper lever, near its centre of motion. This second or upper lever, which points in the opposite direction to the lower one, is very light, and carries at its free end a pen, which records, on a plate moved by clockwork, the vertical movements transmitted to it through the first lever, from the spring resting on the artery. By this arrangement of levers the movements originally received by the spring from the artery are amplified some fifty times in the record.

The tracing is called a *pulse-trace* or *sphygmogram*, and consists of a series of pulsations, varying in number and form according to the frequency and the characters of the pulse. *See* PULSE.

The frame of the instrument, to which the spring is fixed, holds the clockwork by means of which the recording plate is made to travel.

The framework is also made so as to fit easily on the arm, and is retained in position by straps, the arm resting on a suitable pad or cushion.

The regulation of the pressure of the spring on the artery is one of the most important points in the application of the instrument. It requires to be accurately regulated and measured, in order to estimate the character of the pulse, and render a comparison of traces trustworthy, as was first pointed out by the writer. This is effected by a regulator screw connected with the steel spring, and furnished with a registering dial, which records the pressure at which the maximum rendering of the pulse is obtained. By this arrangement, or by a somewhat similar one devised by the late Dr. Mahomed, the tension of the pulse can be fairly estimated by the sphygmograph.

APPLICATION.—In the application of the instrument, the first important point to observe is accuracy of adjustment of the ivory pad of the spring over the radial artery. This can be best done by marking the position of the artery with ink, and then carefully adjusting the spring. Secondly, the pressure on the artery must be regulated by means of the pressure screw, so as to obtain the greatest amplitude of movement by the lever, and the record of all the waves of the pulse. Thirdly, the friction between the recording pen and the receiving plate, on which the trace is recorded, must be reduced to a minimum. Smoked glass and paper are the best receivers; pens that write with ink are apt to blur the finer features of the trace. The tracings on smoked glass or paper are fixed and rendered permanent by varnish; the tracing papers, which should be well enamelled, may be smoked by being held over burning paraffin or camphor, or even over an ordinary vesta match. When the traces are recorded, they may be fixed by varnish made of gum benzoin, or Burgundy pitch in methylated spirit (1 in 8), or ordinary tincture of tolu.

Uses.—The applications of the sphygmograph to clinical inquiry are numerous and important. Precision is given to the study of the pulse, and by the aid of a graphic representation of its form the finger is taught what to feel. A pulse-trace (*see* Pulse, *which should be read with this article*) shows at a glance the rate, regularity, and equality of the heart-beats. Irregularities, and especially inequalities, that escape the finger, are registered; and indications as to pulse-tension and heart-strength, most important for prognosis and treatment, are obtained. In acute visceral inflammations, for instance, slight inequalities in the pulsations otherwise unrecognisable may be recorded, and the first signs of heart-failure, and the necessity for stimulants, thus suggested. Again, the undulatory pulse of a ventricle, too weak to resist respiratory influences, is disclosed in the tracing; and prognosis and treatment may be correspondingly modified.

Indications.—The evidence yielded by the sphygmograph mainly concerns: (1) The mode of the heart's contraction. (2) The condition of the peripheral circulation. (3) The state of the arteries and their coats. (4) Valvular diseases of the heart.

1. The Mode of the Heart's Contraction.—The sphygmographic tracing shows this by the line of ascent. When the heart-muscle acts suddenly and vigorously, the line is vertical and lofty, and terminates in a pointed summit-wave. Unless the vessels are over-full of blood, there follow well-marked tidal and dicrotic waves. On the other hand, when the heart's contraction is feeble, the line of ascent is less vertical and lofty; the summit wave is less distinct; and the tidal and dicrotic waves are less, or the former is blended with the summit wave. The pulse, moreover, unlike the pulse of a vigorous ventricle, is easily obliterated by pressure. A note of the pressure at which the most perfect trace is collected should always be made, as it enables the observer to compare results at different times.

2. The Condition of the Peripheral Circulation.—The easy or difficult passage of the blood through the arterioles and capillaries, causing low or high pulse-tension, is estimated by the pressure required to develop or to obliterate the three waves, but more especially the tidal and dicrotic waves. Obstructed peripheral circulation is manifested by increase of the tidal wave, diminution of dicrotism, and lessened height of line of ascent and summit wave (fig. 139). The heart, apart from febrile or nervous excitement, contracts less suddenly under these conditions. On the other hand, in easy and quick capillary circulation, such as occurs in fevers, the sudden heart-contraction causes a more vertical and higher line of ascent, exaggerates the summit wave, lessens the tidal wave, and fully develops the dicrotic wave (fig. 140). In such conditions the fully dicrotous and hyperdicrotous traces are recorded (fig. 141). The rapid onflow of blood is, moreover, shown by the more sudden fall of the line of descent. It is by the comparative study of the three waves, and the pressure required to record them fully, that we obtain valuable indications as to heart-strength and pulse-tension in acute diseases, and in the earliest stages of some chronic affections.

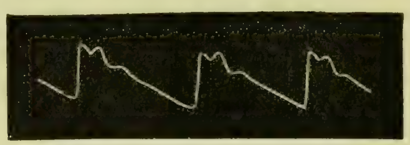
Fig. 139.

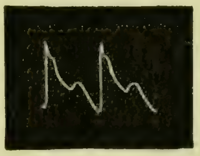
Fig. 140.

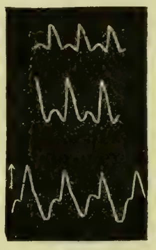
Fig. 141.

3. The State of the Arteries.—There are three chief conditions of the arteries that modify the pulse: (*a*) The state of the *muscular* coat; (*b*) *degenerative* conditions of the arterial walls; and (*c*) the presence of *aneurysm*.

(*a*) When the *muscular* coat is contracted, the artery imparts to the finger a hard, wiry sensation, which shows in the trace by a short line of ascent, and the blending of the summit and tidal waves in an oblique line of descent, scarcely broken by dicrotism (fig. 142). In the opposite condition of relaxed arterial coats, the dicrotic and summit waves are enlarged, and the tidal waves lessened. These changes can be experimentally illustrated by the application of cold and heat to the surface of the body. The cold and hot stages of ague also show the two states.

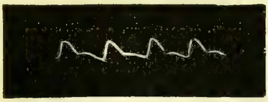

Fig. 142.

(*b*) *Inflammatory* and *degenerative* processes lead to rigidity of the arteries, whereby the modifying influence of their elasticity on the blood-movement is lost. The blood-wave in the radial artery consequently approaches more to that imparted by the heart's systole. In these conditions the pulse often beats visibly, so that we are prepared for the amplitude of the trace. The tidal wave is large, nearer to, and often blended with the summit wave, while the dicrotism which occurs early in the line of descent is badly marked. The presence of these peculiarities often leads to the early diagnosis of unsuspected atheroma of the great vessels (fig. 143).

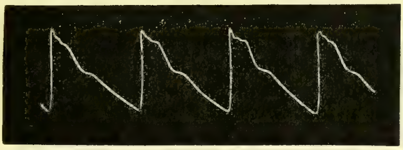

Fig. 143.

(*c*) When the sac of an *aneurysm* is seated on a main trunk after its origin from the aorta, it acts as an elastic bag, and so modifies the pulse-form by rendering the line of ascent oblique, diminishing or abolishing the summit wave, modifying the dicrotism, and more or less converting the three waves into a simple curve. To the finger these changes mean retardation (oblique line of ascent) and diminution of force (loss of summit wave). Such peculiarities in the left radial artery are produced by an aneurysm of the left subclavian, or in the right radial by innominate aneurysm. When the aneurysm is connected with the thoracic aorta in its ascending portion, there is frequently a dissimilarity between the two radial pulse-traces, which is persistent, one being smaller than the other, more vibratory, or more easily obliterated by increased pressure. The pulse usually more affected is the right, as the aneurysm tends to implicate the innominate artery. In aneurysm of the transverse portion of the arch, the left pulse is more commonly diminished in force and amplitude (figs. 144 and 145). In aneurysms of the descending thoracic and abdominal aorta, the dicrotic wave is often much increased in both pulses, while the right radial yields usually the more normally developed trace.

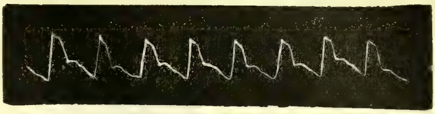

Fig. 144.—Right Radial Tracing.

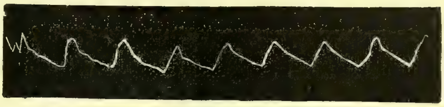

Fig. 145.—Left Radial Tracing.

These signs may be more or less simulated by pressure of tumours on the arterial trunks, or by their partial obstruction by clots. The sphygmographic signs of aneurysm, therefore, require to be confirmed by the use of the ordinary means of diagnosis. In some cases, however, the pulse-traces alone suffice to indicate the lesion and its seat.

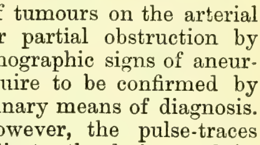

Fig. 146.

4. Valvular Diseases of the Heart.—Valvular diseases of the heart generally influence the pulse-trace. In *aortic regurgitation* this is strikingly seen (fig. 146). The strong, dilated ventricle contracts suddenly on a large charge of blood, and consequently there is a lofty line of ascent, ending in a pointed summit wave. The tidal wave is small in proportion to the trace; and the dicrotism, which occurs later than normal in the line of descent, is generally much diminished, on account of the leakage into the ventricle interfering with the rebound of the blood-column from the closed valves. The dicrotic wave, thus starved, is followed by a rapid fall in the tracing, showing the quick emptying of the artery. It is this contrast between the height of the summit wave and the rapid fall of the trace, unbroken by any *sustaining* wave, that gives the pulse its splashing and collapsing character. These features, the small dicrotism and the rapid fall, indicate the amount of regurgitation. In some cases of this valve-lesion the tracing shows a well-marked tidal wave and a fairly developed dicrotic wave; and increased pressure by the spring of the sphygmograph, instead of obliterating the trace as usual, shows that there is a fair amount of tension. Such features commonly occur in older persons, in whom the valve-defect is small and due to atheroma, and not to rheumatism, and the pulse-form is modified by the addition of the characters of the pulse of degenerated arteries. When such features are observed in rheumatic cases, and the trace more resembles the normal form, they point to perfect compensation and small valve-defect

In *aortic stenosis* the trace testifies to the amount of the lesion. When the narrowing is extreme the summit wave is lost, the line of ascent becomes oblique and gradual, and the pulse is felt to be retarded. More commonly a break in the line of ascent marks the position of the summit wave, while above it rises the large tidal wave, due to the strong systole (fig. 147). Such pulse traces are called *anacrotic*, to distinguish them from the *katacrotic* traces with all their waves in the line of descent. In cases in which the obstruction is less in degree, the summit of the tracing may be forked by a sharp division between the summit and tidal waves. The dicrotic wave is lessened. The loss or checked development of the summit wave, followed by an exaggerated tidal wave, arising from a strong and often dilated ventricle, pushing a large blood-wave *gradually* into the arteries through the narrowed aortic orifice, are the characteristics of this lesion when pure. When it is associated with aortic regurgitation, the large tidal wave is still pronounced.

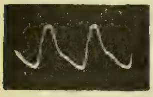

Fig. 147.

Mitral valve lesions, which are less immediately connected with the arterial blood-movement, present less decided characteristics.

In *mitral regurgitation* the tracing is often of the normal outline, and in such cases the compensation is fairly perfect. In some cases, in addition to great rapidity, the pulse is small and shabby, in striking contrast to the vigour of the impulse (fig. 148).

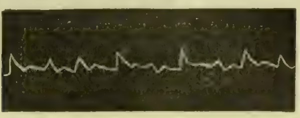

Fig 148.

The line of ascent is sloping, and the tidal and dicrotic waves poorly defined. In other cases great irregularity is the chief feature of the trace, a series of small, ill-developed pulse-waves being succeeded by large and well-formed pulsations. On analysis, the series of small, ineffectual heart-contractions correspond to inspiration, and the fuller and more vigorous ones to the respiratory pause. In other conditions similar irregularities are caused by the same influences. Dr. Burdon Sanderson, who first referred these irregularities to their cause, says: 'The mechanical effect of inspiration is to augment the quantity of blood contained in the pulmonary circulation, and hence to increase the frequency of the contractions of the heart. This increased frequency depends on the distended state of the auricles, in consequence of which the ventricles fill more rapidly during their period of relaxation. In this way the length of the diastolic pause is diminished, and the hurried action of the heart satisfactorily accounted for; but the question still arises, Why are the rapid beats which occur in inspiration also ineffectual? Very probably because the mitral valve does not close; the heart being distended with blood, its walls are kept apart to such an extent that the curtains do not meet. The ventricle contracts, but much of its blood is discharged into the auricle, to be returned to the ventricle as soon as its contraction is over. It is not until the effect of inspiration in keeping the auricles full ceases, that the curtains get near enough to allow the heart to make an effort sufficiently effectual to send a full tide of blood into the aorta, and thus relieve the distended pulmonary circulation.'

Similar peculiarities are occasioned by the same mechanism in tricuspid regurgitation and dilated heart.

In *mitral stenosis* the sphygmographic evidence is very important. The pulse-tracing shows irregularity in the line of descent, which often is greatly prolonged through a missed pulsation—a true intermission in the beat, and sometimes broken by the interpolation of a small, abortive pulsation (fig. 149). These abortive pulsations are due to over-distension of the auricle, causing premature auricular contractions, which propagate themselves to the ventricle, and so produce a ventricular contraction on a small charge of blood. They mostly occur during inspiration, from the causes above mentioned. The rhythmical relations between the contractions of the auricle and the ventricle are thus disturbed, and hence the features just described.

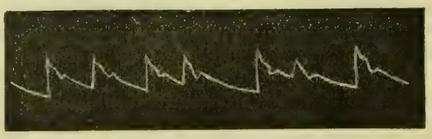

Fig. 149.

These are the special characters of the pulse of mitral stenosis. In some cases, where the stenosis is not great and the compensation perfect, the pulse is regular in time and form, or nearly so; but in these cases characteristic irregularities can often be produced by vigorous exertion.

Finally, in therapeutical investigations the sphygmograph is indispensable as a means of discovering the influence exerted by a drug on the state of the vessels, on the condition of the peripheral circulation, and on the vigour of the heart. The modifications in the form of the pulse-trace above described enable the investigator to estimate these effects. B. Walter Foster.

SPINA BIFIDA (*spina*, the spine; and *bifida*, cleft).—Synon.: Fr. *Hydrorhachis Congénitale*; Ger. *Rückenspalte.*

Definition.—A congenital malformation, with arrest of development, of the laminæ and spinous processes of some portion of the spinal column.

Generally there is a deficiency of two or three spinous processes and the laminæ; the rudimentary portions of the arches of the vertebræ being spread out and irregularly expanded. The spinal cord being thus left unprotected, its membranes protrude through the aperture posteriorly, forming a kind of hernial tumour.

Anatomical and Clinical Characters.—At birth the tumour in spina bifida is generally about as large as a walnut, and either spherical or ovoid in form. It may be met with in any part of the spinal column, but with rare exceptions it occurs in the lumbar or lumbo-sacral region. The tumour is filled with cerebro-spinal fluid, and is therefore always tense, with distinct fluctuation; its tension increases when the child cries, and may be diminished by pressure. The cutaneous covering of the tumour is generally very thin and attenuated, sometimes having the appearance of a transparent membrane, of a bluish or congested colour. In other cases the skin is of its normal thickness and colour. The nerve-trunks, forming the cauda equina, frequently traverse the interior of the sac in the median line, and after being reflected from the posterior wall of the sac, recross its cavity towards their normal distribution. The tumour is nearly always solitary, but cases in which a second enlargement existed have been recorded.

Diagnosis.—Difficulty in the diagnosis of spina bifida can hardly ever occur, and the characters above described will readily distinguish it from the congenital tumours of a fatty, fibrous, or cystic character occasionally met with in the same situation.

Complications.—Spina bifida is sometimes associated with hydrocephalus, with club-foot, or, it is said, with some paralytic symptoms; the latter complication probably occurring only in those cases in which the nerves of the cauda equina traverse the sac of the tumour.

Course and Terminations.—The majority of cases of spina bifida terminate fatally, often within a few days or weeks of birth; the children dying from convulsions, frequently preceded by rupture of the sac, and the escape of its contents. When the fluid only oozes gradually, relief follows; and sometimes spontaneous and complete cure thus occurs, the tumour contracting to a small nodule, and the aperture in the canal closing more or less completely. In some cases, when the cutaneous covering is thick and normal, the tumour may gradually increase in size without material inconvenience, up to the adult period of life, attaining the size of a child's head, or even larger dimensions.

Prognosis.—This must generally be unfavourable, especially when the tumour is of large size at birth, and its covering only thin, membranous, and vascular, with a broad base. When the base of the tumour is narrow, and its cutaneous covering thick and normal, the prognosis may be more favourable, especially if the malformation be situated on the sacrum.

Treatment.—The result of any treatment of spina bifida must be extremely doubtful, but in many cases the process of spontaneous cure has been successfully imitated by small tappings frequently repeated, and followed by light compression, covering the tumour with cotton wool or lint, and strips of plaster. Only a portion of the fluid should be allowed to escape at the time of operation; and the puncture should always be made at the side of the tumour, so as to avoid any possible injury to the nerve-trunks which may traverse the sac. Cases have been successfully treated by the injection of small quantities of iodine. Dr. J. Morton of Glasgow has used a solution made by dissolving 10 grains of iodine and 30 grains of iodide of potassium in an ounce of glycerine—half a drachm of which solution may be injected, without allowing the fluid contents of the tumour to escape, at intervals of a week or ten days. The writer has seen a case successfully treated in this way by the late Dr. Murray at the Great Northern Hospital; and he has also employed it successfully himself. Other operative measures, such as compression of the neck of the tumour by means of a clamp or ligature, and also excision, have been employed, occasionally with success; but no such attempt should be made except under the most favourable circumstances, when the tumour has a very narrow base—more or less pedunculated, and is situated over the sacrum; otherwise death from convulsions or meningitis would probably follow.

W. Adams.

SPINAL ACCESSORY NERVE, Diseases of.—The upper fibres of the spinal accessory nerve emerge from the surface of the medulla oblongata, below the pneumogastric. They arise from a column of nerve-cells adjacent to the nucleus of the hypoglossal, and continuous with the nucleus of the pneumogastric. The fibres join the latter nerve and innervate the movements of the larynx. Their share in the nerve-supply to the pharynx is undecided, but it is certain that the levator palati is supplied by them. Paralysis of the vocal cord, tongue, and palate is occasionally due to disease at the surface of the medulla in this region, and the fact that stimulation of the roots of this nerve causes movement of the palate has been proved experimentally by Horsley and Beevor. The lower, spinal, fibres of the nerve emerge from the side of the cord as low as the sixth or seventh cervical nerves, and pass through the substance of the lateral columns, arising from the anterior cornua, in common with the motor fibres of the upper cervical nerves. This spinal part of the nerve ascends through the foramen magnum, and is connected with the bulbar portion for a short distance; the two parts then separate, the latter joining the pneumogastric, the former passing to the neck, and supplying the sternomastoid and the upper part of the trapezius. The double relation of the nerve is thus correctly expressed in its name. The bulbar fibres alone are 'accessory' to the pneumogastric; the 'spinal' fibres are strictly part of the motor cervical roots.

1. **Paralysis.**—Ætiology.—The nucleus of origin of the nerve may be diseased by slow degeneration of the motor cells, as in progressive muscular atrophy and chronic bulbar paralysis, and also in syringomyelia and central growths that spread from the cervical region to the medulla. In chronic spinal muscular atrophy the upper part of the trapezius, supplied by this nerve, is often affected later than any other muscle; it is the *ultimum moriens*, as Duchenne called it. The nucleus of origin of the bulbar portion may be damaged by acute processes—softening or hæmorrhage (acute bulbar paralysis); and the grey substance from which the spinal fibres arise may be affected in acute poliomyelitis. The roots of the nerve are sometimes damaged by injuries, such as fracture or dislocation of the upper cervical vertebræ; by narrowing of the foramen magnum; by tumours external to the cord; and especially by meningitis, syphilitic or simple, in this region. The spinal part of the nerve, from its long course, is especially liable to suffer. The nerve is rarely injured in fractures of the skull. The causes of paralysis of the vagal portion, after its junction with the pneumogastric, have been considered in the article on diseases of that nerve. The spinal part, in its course to the muscles, may suffer in rare cases from rheumatic inflammation, or from injury; may be compressed by enlarged glands; or implicated in abscesses in its neighbourhood.

Symptoms.—Paralysis of the spinal accessory may be complete, when the disease involves the nerve where both parts are united, but is much more commonly partial, on account of the extensive origin of the spinal portion, and the early separation of the two divisions. The symptoms indicating disease of the accessory part of the nerve, as loss of movement of the vocal cords, are described in the article on the pneumogastric nerve. The paralysis of the palate, which is so often associated, is best recognised by the defective movement in phonation. *See* Palate, Paralysis of.

The loss of function of the spinal portion of the nerve is shown by paralysis of the muscles which it supplies—the sternomastoid and trapezius. Unilateral palsy of these muscles does not affect the posture of the head; but the head, when behind the vertical position, cannot be rotated to the opposite side. Paralysis of the trapezius, which may occur alone if the disease of the nerve is behind the sternomastoid, is almost confined to the upper part of the muscle, that proceeding from the occipital bone to the clavicle. The middle part of the muscle receives a sufficient nerve-supply from the cervical nerves to prevent conspicuous paralysis or wasting, although the fibres of the spinal accessory can be traced almost to its lower border. The loss of the upper part alters the contour of the neck, and the shoulder is not raised in deep inspiration. The shoulder can, however, still be elevated voluntarily, this movement being effected by the middle part of the muscle. Abduction of the arm by the deltoid is interfered with, on account of the loss of the support afforded by the upper part of the trapezius; and the supplemental action of other muscles causes a slight rotation of the scapula. If the nerve or its origin is damaged by an acute process, the paralysed muscles undergo wasting, which is usually rapid, and is accompanied by the reactions which characterise nerve-degeneration.

Prognosis and Treatment.—The prognosis and treatment of paralysis of the spinal accessory nerve are those of the morbid process causing the paralysis (*see* especially Progressive Muscular Dystrophy; Labio-Glosso-Laryngeal Paralysis; and Pneumogastric Nerve, Diseases of). In all cases, if the muscles waste and present loss of irritability, electricity should be applied, the voltaic current being in most cases required.

2. **Spasm.**—The muscles supplied by the spinal accessory nerve are frequently the seat of spasm, causing 'torticollis,' or 'wry-neck.' The spasm is due to an affection of the centres, probably in some cases those in the medulla, in others those in the cortex of the brain. This affection is described in a special article. *See* Wry-Neck.

W. R. Gowers.

SPINAL CORD, Diseases of.—SYNON.: Fr. *Maladies de la Moelle Epinière*; Ger. *Krankheiten des Rückenmarkes.*—Though the spinal cord is commonly regarded as a single organ, yet it is one which is very composite in structure, and still more so in function. It is in part (1) a mere aggregate of connecting fibres between the body generally and the brain—that is, an accumulation of channels of conduction for sensory impressions of all kinds, both superficial and deep, on their way to the brain; and also for outgoing motor incitations from the brain to all the voluntary muscles of the body, as well as to those pertaining to the viscera and their ducts, and to blood-vessels. In part, however, the cord also consists (2) of a serial aggregation of more or less fused ganglia having to do with the execution of voluntary and all sorts of reflex actions; with the functional activity of organs; and with the nutrition of tissues.

The structural bases for these two principal sets of functions are most intimately knit together; those of the second set are not wholly distinct from those of the first—to a considerable extent they are the same elements, capable of being called into play voluntarily, as well as in a reflex manner.

In order to facilitate references in the special articles on diseases of the spinal cord to the details set forth in this *Introduction*, it will be divided into a series of numbered sections.

§ 1. General Relations and Structure of the Spinal Cord.—Continuous with the bulb or medulla oblongata above, the spinal cord begins at the level of the upper border of the body of the first cervical vertebra, whilst it ends in a narrow pointed extremity opposite the upper part of the body of the second lumbar vertebra, or perhaps a trifle higher. Throughout the whole of this extent it is enclosed within the narrow spinal canal, and is invested by two membranes, the *pia mater* and the *arachnoid*. Beneath the latter and in the meshes of the looser pia mater there is situated (as around the cerebrum) a certain amount of cerebro-spinal or subarachnoid fluid. Enveloping the cord much more loosely, outside the arachnoid, is the firm spinal *dura mater*.

The arrangement of the several anatomical components of the spinal cord is essentially similar throughout its extent. Its two halves are marked off from one another in front by the deep 'anterior longitudinal fissure' (fig. 150 A), and posteriorly by a median septum of connective tissue rather than by an actual fissure. Each half contains a central mass or core of grey matter, shaped something like a comma. The grey masses in the two halves of the cord are turned back to back, and are connected with one another by means of an intervening bridge of matter, answering to the 'grey commissure.' In front of this bridge of grey matter lie some white fibres, constituting the 'white commissure.' Through the centre of the grey commissure there runs a fine canal—the *central canal* of the cord—which is lined with a layer of epithelium-like cells.

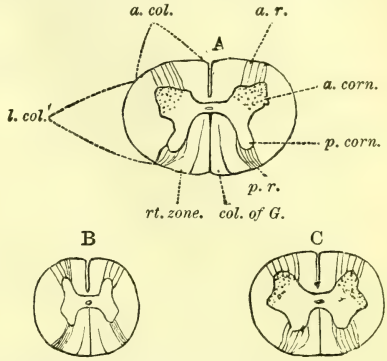

FIG. 150.—Diagrammatic representations of transverse sections of Spinal Cord, 1½ natural size. A. Through middle of cervical swelling; *a. col.*, anterior column; *l. col.*, lateral column; *rt. zone*, root zone; *col. of G.*, column of Goll; *a. r.*, anterior roots; *p. r.*, posterior roots; *a. corn.*, anterior cornu; *p. corn.*, posterior cornu. B. Section through mid-dorsal region. C. Section through middle of lumbar region.

These figures show, pretty accurately, the relative proportions of the different component parts of the cord in the three situations named.

The thick anterior extremity of the grey matter in each half of the cord is known as the *anterior cornu*, and the much thinner posterior extremity as the *posterior cornu.* This latter approaches near to the surface of the cord in its postero-lateral region, and is here joined by the *posterior roots* of the spinal nerves. Their point of entry on each side divides the white substance of the corresponding half of the cord into posterior and antero-lateral columns. The portions of the white substance of the cord lying behind and between the posterior roots constitute the two *posterior columns*, each of which is again subdivided by a slight superficial fissure into a postero-external tract or *root-zone* ('*column of Burdach*'), and a postero-internal wedge-shaped portion, or '*column of Goll.*' The portions of the white substance which on each side lie in front of the posterior roots constitute the *antero-lateral columns.* The inner portions of the anterior columns border upon the anterior fissure, but there is no real line of demarcation to define the bounds of the anterior and of the lateral columns respectively, because the anterior roots are connected with the anterior cornua in a diffuse or scattered manner, and not in a compact bundle like that formed by the fibres of each posterior root.

For some particulars concerning the *blood-vessels* of the spinal cord, *see* § 5, (8) and (9).

§ 2. **In-going Channels of Conduction to the Brain.**—The paths for these impressions soon after their entry into the spinal cord by the posterior roots were formerly supposed to cross to the opposite half of the cord, decussating with their fellows of the other side. But, according to the more recent researches of Mott, this is not the case. He concludes that painful impressions, and those of temperature (heat and cold), are conducted up both sides of the cord; but that touch and pressure sensations associated with localisation, and likewise muscular-sense impressions, are chiefly conducted up the same side.

Impressions of pain, as well as those of heat and cold, after passing with the nerve-roots through portions of the posterior columns, principally traverse the central regions of the grey matter of the cord. Disease or damage of these posterior columns, as well as of the grey matter, often causes a more or less marked retardation in the transmission of such impressions.

Impressions of touch and pressure are supposed to travel in the main by the *posterior columns*, though possibly some of them ascend in portions of the lateral columns. But Tooth has brought forward reasons for doubting this (*Journ. of Physiol.* 1892), and inclines to the view that they may travel upwards through the substantia gelatinosa of the posterior horns, mainly on the same side, though to some extent on the side opposite to that at which they enter the spinal cord.

The paths traversed by impressions from muscles to the encephalon (so important for the regulation of movements) are not distinctly known; but they are probably double, and to be found in the posterior as well as in the lateral columns. Those in the posterior columns may go to the cerebrum, and those in the lateral columns to the cerebellum ('direct cerebellar tract'). These channels—that is, those going to the cerebrum—were long ago said by Brown-Séquard to decussate in the pons Varolii, rather than soon after their entry into the spinal cord.

The path for the transmission of impressions from the 'genital centres' in the lumbar region of the cord to the brain is probably situated in the posterior columns.

§ 3. **Out-going Channels of Conduction from the Brain.**—All that is certainly known concerning the spinal paths for voluntary motor incitations is that, below the decussation of the pyramids, they are to be found mainly in the posterior part of the lateral column ('crossed pyramidal tract'). The fibres descend through these columns to different levels, according as their stimuli are destined to evoke the activity of different nerves and muscles; thus, if a movement of the arms is to be excited, they go only as low as to some part of the cervical enlargement; but if the movement is of the legs, as far as to the lumbar swelling. In each case such motor fibres then penetrate the grey matter (anterior horns), and come into relation with some of the great nerve-cells contained therein, whence outgoing fibres arise, which cluster together outside the cord, and constitute the fibres of the anterior roots. The motor paths for the foot and leg, in the lumbar lateral column, are said to lie more towards the circumference of the cord than those for the thigh-muscles.

On the other hand, some (see p. 803) of the pyramidal fibres of the medulla pass into and through the spinal cord on the same side, that is without decussating, and constitute the inner part of the anterior columns ('direct pyramidal tract'). It seems probable that these fibres of the direct pyramidal tract gradually decussate along their whole course through the cord, their fibres passing through the anterior commissure and through the grey matter to reach the lateral pyramidal tract of the opposite side of the cord.

It is probably an error to suppose, as some have imagined, that there are any special routes for the conduction of reflex motor impulses from the brain, apart from those concerned with the excitation of voluntary movements.

During recent years additional information concerning the composition and functions of the different columns of the spinal cord has been obtained by the study of so-called 'secondary degenerations' (*see* § 5 (13)), by developmental investigations (Flechsig), as well as by clinico-pathological research, and experiments upon animals. In this way we have come to recognise the existence of 'tracts' in the spinal cord other than those to which reference has already been made, and to learn that, though each tract is for the most part composed of fibres of the same order, it is not wholly so. In some regions, as we shall see, there are even in the same tract or part of a tract both afferent and efferent fibres.

A better understanding of the exact situation and relative size of the several tracts already referred to, as well as of those about to be described, may be gathered from a study of fig. 151, after Schäfer.

Of the tracts already mentioned, the columns of Goll and the columns of Burdach, which together constitute the whole of the posterior columns of the cord, are composed almost wholly of direct continuations of the posterior nerve-roots. This has been proved by cutting these nerve-roots in the sacro-lumbar and in the dorso-cervical regions respectively, and subsequently studying the secondary degenerations thus occasioned. The lower the root the more mesial is the resulting long degeneration in the higher parts of the cord

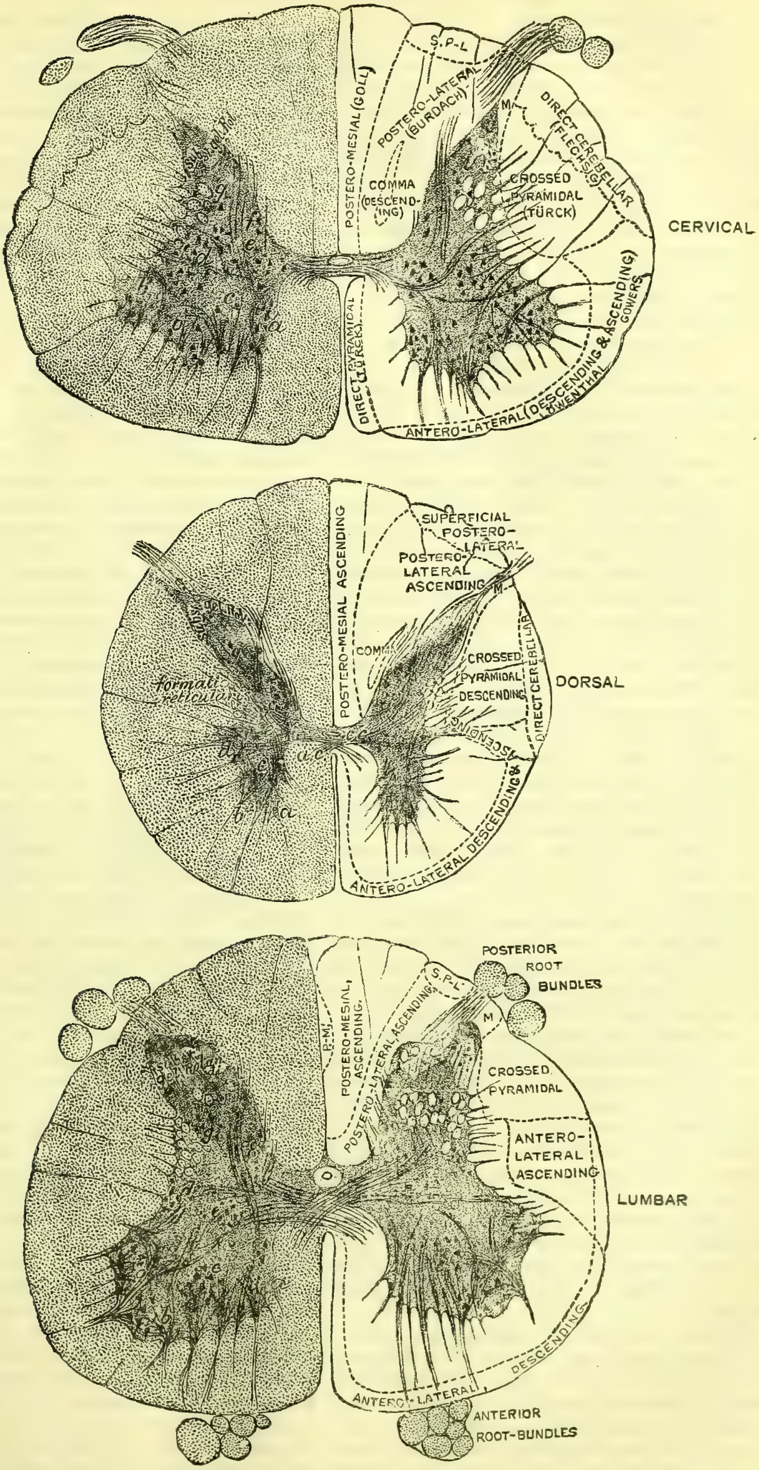

Fig. 151.—Sections of Spinal Cord in lower cervical, mid-dorsal, and mid-lumbar regions (Schäfer). On the right side of each section the conducting tracts are indicated.

and in the medulla oblongata. Thus Schäfer says (*Quain's Anatomy*, 10th ed. vol. iii. p. 28): 'With regard to this degeneration in the posterior mesial column, it is to be noted that, while that which results from section of the lower (lumbo-sacral) roots occupies in the higher parts of the cord the postero-median angle as above described, the degeneration resulting from section of the dorsal roots lies next to this; that resulting from section of lower cervical roots passes up Goll's column in its lateral part next to the column of Burdach; and finally that resulting from section of upper cervical roots is confined to Burdach's column. and ends in the nucleus cuneatus of the medulla oblongata. . . . The fibres. as they enter the cord with the posterior nerve-roots, form in fact a succession of lamellar tracts. which lie in each case at first next to the posterior cornu, and become gradually shifted medianwards by those which enter the cord with the higher nerve-roots.' These degenerations from sections of the nerve-roots diminish markedly in amount as they are traced up the cord, and that which remains is eventually confined to a part of the posterior column which contains normally fine or medium-sized fibres only. 'From this it may be inferred,' Schäfer says, 'that the larger fibres of the posterior roots—which in fact form the bulk of these roots—have a relatively limited course after entering the cord. They probably end by their collateral branches, and ultimately by their main ascending branches, turning into the grey matter and breaking up into terminal ramifications in the fine interlacements of nerve-fibrils which occur in the neighbourhood of the nerve-cells and cell-groups.'

Of late years a small area of descending degeneration has been recognised in Burdach's column, in the cervical and dorsal regions of the cord more especially, and to this, on account of its shape, the name 'comma tract' has been given. According to Dr. Mott, this degeneration occurs not only in sections of the cord, but also from section of posterior nerve-roots. It is remarkable from the fact that it extends only for a very short distance below the lesion; and it has been suggested, with much probability, that this area may represent the descending branches of the cut posterior roots. It has, of course, long been known that, on their entrance into the spinal cord, the posterior roots divide into descending as well as into ascending bundles.

Afferent impressions are conveyed, however, to the cerebrum, not only by the different tracts entering into the composition of the posterior columns, but also, as we have seen, through the grey matter; whilst they are conveyed to the cerebellum along two tracts forming part of the lateral columns. One of these, known as the 'direct cerebellar tract' (Flechsig), begins to appear in the upper part of the lumbar enlargement, as a compact bundle of fibres at the periphery of the posterior half of the lateral column, just outside the crossed pyramidal tract. This fasciculus increases in size by the constant accession of new fibres as it passes upwards through the dorsal and cervical regions of the cord. It is generally supposed that these fibres emanate from the cells of Clarke's column (situated at the inner and central part of the posterior cornu), and that they pass upwards by way of the restiform body to the cerebellum. The other afferent cerebellar tract is known as the 'antero-lateral ascending tract' (Gowers). It was formerly confounded with the direct cerebellar, and supposed to be its anterior prolongation; but it was shown by Gowers to be a distinct fasciculus, the fibres of which come from the lumbar region of the cord below the commencement of the direct cerebellar tract. It is often wedge-shaped or rounded, lying in front of the 'crossed pyramidal tract.' It can be traced upwards into the bulb and pons Varolii, and then enters the cerebellum with the superior peduncle, passing mainly to the vermis. Its fibres are intermingled with those of the 'descending cerebellar tract,' to which reference will presently be made.

All the paths for afferent impressions to the cerebrum, with the exception of those for muscular sense, were, as before stated, formerly supposed, soon after their entry into the spinal cord by the posterior roots, to decussate with their fellows of the opposite side (Brown-Séquard). But according to the recent researches of Dr. Mott this is not the case. He comes to the conclusion that painful and thermal impressions may be conducted through either or both sides of the grey matter; but that tactile and pressure sensations are chiefly conducted up the same side of the cord, and that the same holds good for muscular-sense impressions. Mott's view is borne out by the fact that the secondary degenerations, resulting from sections of the posterior roots, are always limited to the same side of the cord; and likewise by the fact that hemisections of the cord when they are quite unilateral show no degeneration in the posterior column of the opposite side.

If we sum up, then, all that is known or legitimately surmised concerning the paths for afferent sensations through the cord, it comes to this: Both the direct cerebellar and the antero-lateral ascending tract convey impressions to the cerebellum; the former has been supposed to convey impressions of the muscular-sense order, and the latter, if it does not convey impressions of the same kind, may give passage to impressions of common sensibility serving as additional incitations to some of the complex reflex actions regulated by the cerebellum. On the other hand, the columns of Goll are also commonly supposed to transmit muscular-sense impressions, though the ultimate destination of these may be to the cortex in the Rolandic areas of the cerebrum. The evidence derived from syringomyelia make it highly probable that painful and thermal impressions reach the cerebrum by way of the central grey matter, in accordance with the views of Schiff. As to impressions of touch and pressure nothing definite is known; the paths for these impressions may lie partly through the columns of Burdach, and partly through the grey matter of the posterior horns (Tooth), as the only other ascending tracts seem to be a series of short commissural fibres running through the lateral columns, and serving to connect the nerve-cells at various levels of the posterior cornua with one another.

In addition to the crossed and the direct pyramidal tracts, there are two other columns seeming to contain outgoing fibres in each half of the spinal cord. The most important is known as the '*antero-lateral descending cerebellar tract*,' which consists of fibres that are connected with cells in the cerebellar cortex of the same side, and which undergo degeneration on removal of the corresponding half of the cerebellum (Marchi). These fibres form an extensive circumferential tract in the anterior three-fourths of the antero-lateral column, spreading inwards in front of the crossed pyramidal tract to reach the intermedio-lateral tract of the grey matter. The tract which is thus marked out is most extensive in the upper regions, and gradually lessens in the lower part of the cord, but can be traced almost to its termination. It embraces in the dog the part of the anterior column which in man is occupied by the direct pyramidal tract, and also the whole region of the tract of Gowers, the fibres of these two tracts being intermingled. Some of the fibres of the anterior roots also exhibit degeneration after removal of the cerebellar hemisphere, and are therefore probably directly continued from fibres of this tract.

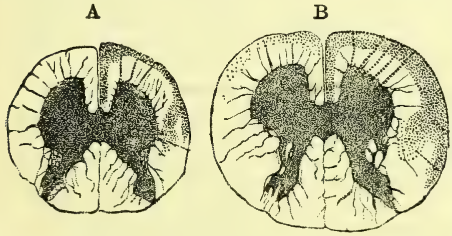

FIG. 152.—Sections show the 'Descending Cerebellar Tract' in the spinal cord of the Dog, following upon extirpation of the left half of the cerebellum. (Schäfer after Marchi); A, Lumbar Cord; B, Cervical Cord.

The degeneration is in the antero-lateral column of the same side as the lesion, except in B, where there is a little degeneration on the opposite side.

The same holds good for nearly all the efferent cranial nerves (Marchi). These degenerated fibres are numerous on the same side as the lesion, but a few occur in the opposite nerves.

The other tract formerly thought to contain outgoing fibres is now believed, with more probability, to belong really to the afferent system of fibres. It is known that the posterior roots of the spinal nerves divide on their entrance into the cord into two main longitudinal branches, ascending and descending. Of these the ascending branch has been hitherto principally referred to, but the descending branch ought also to undergo degeneration. But the only descending degeneration in the posterior columns occurs in a small tract which is known (from its shape) as the 'comma tract.' As already stated, Dr. Mott has found that this degeneration occurs not only in sections of the cord, but also after section of the posterior nerve-roots, and that on each occasion it extends downwards for a limited distance only (half to three-quarters of an inch). It seems, therefore, most probable that this degeneration of the comma-tract represents the degeneration of the fibres belonging to the descending branches of the posterior roots.

§ 4. **Spinal Reflexes.**—The reflexes of purely spinal mechanism which are of importance (by their presence, absence, or variation) as indications of disease of the spinal cord in different longitudinal regions have been divided into (*a*) the superficial or *skin* reflexes, and (*b*) the deep or so-called '*tendon* reflexes.'

(*a*) *Skin reflexes.*—The most important of these are tabulated on page 800. The designation of the parts of the cord upon which they severally depend is based upon a very useful table published by Dr. Gowers.

These skin-reflexes vary much in different individuals, as regards the facility with which they may be obtained. They are often more marked in children and in women than in men; though when the latter are of an irritable or nervous temperament, some or all of the skin-reflexes may in them be well-marked even in conditions of health. It must be borne in mind, also, that the superficial reflexes are always distinctly exaggerated, when the corresponding skin regions are tender in association with related visceral disease (Head).

In cases where extensive transverse lesions exist, situated higher up in the cord than the nerves upon which any of these reflexes depend, such reflexes are commonly supposed to be exaggerated in intensity. This, however, is not the case where we have to do with total transverse lesions. The fact that this or that reflex exists, shows not only that the afferent and efferent nerves, but

Name of Reflex	Mode of Excitation	Nature of Result	Level of Cord upon which Reflex depends
Plantar reflex	Tickling sole of foot	Movements of toes; of these and foot; or of these and leg	1st, 2nd, and 3rd sacral nerves (lower part of lumbar enlargement)
Gluteal reflex	Irritation of skin of buttock	Contraction of glutæi	4th and 5th lumbar nerves
Cremasteric reflex	Irritation of skin of upper and inner part of thigh	Drawing up of testicle	1st and 2nd lumbar nerves
Abdominal reflex	Irritation of skin of abdomen along edge of ribs, and above Poupart's ligament	Contraction of upper or of lower part of abdominal muscles	8th to 12th dorsal nerves
Epigastric reflex	Stroking side of chest over 6th and 5th intercostal spaces	A dimpling of corresponding side of epigastric region (contraction of highest fibres of rectus abdominis)	4th to 6th or 7th dorsal nerves
Scapular reflex	Irritation of skin in interscapular region	Contraction of posterior axillary fold (teres), or of several of scapular muscles	6th or 7th cervical to 2nd or 3rd dorsal nerves

that the path through the spinal cord at the corresponding level, is practically undamaged. It is not, however, necessarily true that absence of any of the reflexes is an indication of disease at the corresponding level in the spinal cord. It may be so; but it may also be that the disappearance of the reflex is dependent upon disease in some part of the afferent or of the efferent nerves, leaving the cord itself intact. Or it may also happen that the particular reflex is simply not to be obtained in the individual under examination. Or, again, with a complete transverse lesion in the lower cervical or in the upper or mid dorsal regions of the spinal cord in man all reflexes dependent upon lower portions of the cord, excepting perhaps the plantar, will (though this is contrary to usual belief) be found to be abolished. *See* Spinal Cord, Special Diseases of: 9. Softening of.

Further, it must be borne in mind that in certain cases of hemiplegia (even where hemianæsthesia does not co-exist) these skin-reflexes are often notably diminished or even abolished on the paralysed side of the body; though the reverse condition of things will probably obtain in regard to the deep or 'tendon reflexes' next to be considered. It will probably be found, hereafter, that this repressing effect upon the skin-reflexes is associated with the existence of lesions in special parts of the brain, and not with lesions in other localities, though such several sites are at present very imperfectly known.

(*b*) '*Tendon reflexes.*'—Much discussion has taken place as to whether these are 'reflexes' at all, in the proper sense of the term. Into this question we do not propose to enter. The phenomena themselves, to which alone reference will be made, are chiefly two in number, namely, *ankle-clonus*, and that variously known as the *knee phenomenon*, *patellar tendon-reflex*, *knee-reflex*, or *knee-jerk*. Corresponding phenomena are met with in the upper extremities in the form of 'wrist-jerk' (produced by a slight blow over the radial side of the wrist), and 'elbow-jerk' (from a blow upon the triceps tendon). These phenomena are increased or diminished under the influence of the same kind of conditions that cause increase or diminution of the 'knee-jerk,' so that no further special reference will be made to them.

There is a distinct difference in regard to the importance of the presence of the 'knee-jerk' and 'ankle-clonus' respectively. The 'knee-jerk' occurs in health, so that it is its absence, as well as its increase, which is of principal significance in certain diseases. 'Ankle-clonus,' on the contrary, is a phenomenon not to be obtained in a state of health, so that its presence was formerly

Name of Reflex	Mode of Excitation	Nature of Result	Level of Cord upon which Reflex depends
Knee-jerk	By striking patellar tendon with edge of hand or with percussion hammer, whilst leg hangs loosely over fellow, or over forearm of operator. Also by striking quadriceps tendon, above patella	A single upward jerk of the leg and foot, slight or distinct	2nd and 3rd lumbar nerves
Ankle-clonus	With knee extended or very slightly flexed, by pressing quickly and firmly against anterior part of sole of foot (so as to stretch calf-muscles) and then keeping up the pressure	A series of clonic contractions at the ankle-joint, continuing as long as the pressure is maintained, and instantly ceasing when it is relaxed If the condition is very highly marked it may spread to the whole limb, or even to that of the opposite side	1st to 3rd sacral nerves (lower part of lumbar enlargement)

thought by some to be a positive sign of disease of the spinal cord. But this is a view which requires limitations—and limitations of such a kind as to deprive the manifestation of ankle-clonus of much of its diagnostic significance. It may exist, for instance, after one-sided fits dependent upon disease of the cerebral cortex; and, again, it may exist to a well-marked extent where the antero-lateral columns of the cord are pressed upon at a certain level, even though (as in the condition above referred to) no lateral sclerosis of the cord has been developed.

Both these physical signs have during recent years attracted much attention. Ankle-clonus was originally described by Brown-Séquard in 1858; it was more particularly defined in the human subject by MM. Charcot and Vulpian in 1866; and its diagnostic importance has since been repeatedly enforced by these observers. In 1874 the mechanism of the knee-jerk, and the fact of its absence in certain spinal diseases, especially locomotor ataxy, began almost simultaneously to engage the independent attention of Erb and of Westphal, and subsequently of many other observers. The latest information concerning its mechanism and many of the conditions which modify it may be found in an important memoir by Dr. Sherrington in the *Journal of Physiology*, vol. xiii., No. 6, 1892, pp. 666–672, and in another by Dr. Risien Russell in the *Proceedings of the Royal Society* (vol. liii. p. 430).

For a brief reference to the functional activity of the *vaso-motor centres*, and of their nerves emanating from the spinal cord, *see* § 7, (4) and (5).

§ 5. **Pathological Data concerning the Spinal Cord.**—General Ætiology and Pathology.—The spinal cord itself may be damaged by disease invading it *from without*—that is, taking origin either in the bony canal or in the enveloping membranes; or it may be the seat of *intrinsic* pathological changes. As the former conditions may and do constantly produce functional derangements or actual structural changes of a secondary order in the cord itself, we must take cognisance of them here, so that the various peculiarities as to their occurrence may be made known and considered side by side with those pertaining to the different causes of disease of intrinsic origin, from which they have to be distinguished at the bedside.

(*a*) *Extrinsic Causes.*

(1) *Stabs or bullet-wounds* may involve limited regions and parts of the spinal cord.

(2) *Fracture with dislocation of some of the vertebræ* (as results of severe falls or other mechanical violence) exists as an occasional cause of an associated paraplegia, produced by the crushing of, or pressure upon, the spinal cord. This is most apt to occur in the cervical region, though the dorsal and lumbar regions are, to a less extent, liable to similar accidents.

(3) *Scrofulous caries of the vertebræ* may exist in any of the regions, and may or may not be associated with *angular curvature* in a corresponding portion of the spine. The paraplegia, or other result of interference with the functions of the cord, in the majority of cases of this disease, is not due so much to its compression by diseased bone, as to the irritation and subsequent compression of the cord by inflammatory products.

(4) *Cancer of the vertebræ* occurs either as a primary or as a secondary affection. Such a new-growth may involve the dura mater or not, and as it grows it may at first irritate and subsequently compress the spinal cord itself.

Other diseases of the spine are rare as causes of disease of the spinal cord. Still aneurysmal erosion of vertebræ with subsequent pressure upon the cord must not be forgotten, and very rarely an aneurysm bursts into the spinal canal. Exostoses and enchondromatous growths from the bones may also quite rarely compress the cord.

(5) *Cancer of the spinal meninges, or new-growths of other kinds* (*see* Meninges, Spinal, Diseases of), may also involve irritation, and subsequently compression, of the anterior or posterior nerve-roots or of the spinal cord itself in one or other region. *Hydatids*, again, should be remembered as possible causes of spinal disease, especially where their existence has already been detected in the body in other situations.

(6) *Hæmorrhage into or upon the meninges.*—*See* Meninges, Spinal, Diseases of.

The foregoing groups of causes of disease of the spinal cord give rise to sets of symptoms having a generic resemblance, because in each case *compression* acts upon the cord, or upon the spinal roots and cord, from without, in one or other direction.

(*b*) *Intrinsic Causes.*

(7) *Hæmorrhage* occurs with extreme rarity in the spinal cord. This is due, in the main, to the firmer texture of the cord, and to the greater abundance of supporting connective tissue around its blood-vessels, as compared with that surrounding the vessels of the brain. When hæmorrhage, of idiopathic origin, does take place into the spinal cord, it almost invariably occurs in the softest portion of the organ, namely, its central core of grey matter—and in this region it may extend for some distance upwards and downwards. As a result of falls or blows, also, hæmorrhage into the substance of the cord is a rare event; still, under these conditions, it occurs occasionally—mostly in association with laceration of the substance of the cord. Of this latter kind of lesion, resulting from a fall

from a height of about twenty-five feet, the writer has recorded a remarkable instance (*Med.-Chir. Trans.*, vol. l., 1867), in which, although the cord was severely lacerated, there was no external wound and no fracture or dislocation of vertebræ.

(8) *Embolism* occurs with great rarity in the spinal cord, and is still more seldom recognised when it does occur. This is due to the fact of the small size of the arteries of the cord, and, as compared with the frequency of embolism in the brain, to the absence among them of any large trunk, like the middle cerebral, coming off more or less directly from one of the great vessels arising from the arch of the aorta. Emboli are known to reach the brain much more rarely by way of the vertebrals than by way of the carotids; and the principal arteries of the spinal cord are either direct offsets from the vertebral (anterior spinal), or indirect branches from the same (posterior spinal)—the latter arising from the inferior cerebellar, which are twigs from the termination of the basilar artery. Apart from these vessels, the blood-supply of the cord comes from still smaller twigs, derived from the intercostal and lumbar arteries, which anastomose with and reinforce the anterior and posterior vessels, at intervals, along the whole length of the cord. All the principal vessels, small though they are, seem to anastomose freely with one another. Thus, even if embolism of spinal arteries should occur, as it probably does very rarely, its effects would be diminished in importance, and obscured clinically as well as *post mortem*, by reason of the very small size of the vessels, and also by the fact of their not being 'end' arteries.

(9) *Thrombosis* would, however, be capable of occurring in diseased spinal *arteries*, as well as in those of other parts of the body. Subsequent observations may perhaps show that degenerative changes or endarteritis are particularly common in the spinal arteries, so that the occurrence of thrombosis in them would thereby be rendered all the more easy and likely to occur. Once set up, the process of thrombosis might easily spread in this network of small spinal vessels, and yet be very difficult to be recognised in them except by the effects that would be produced upon the tissue of the spinal cord—namely, the production of softening. A similar process may also take place in the peculiarly tortuous network of *veins* which surrounds the spinal cord on all sides—perhaps even with more facility than in the veins of other parts—when general and other local conditions favour its occurrence. Ollivier, in fact, called attention to the probably natural slowness of the blood-current through the spinal veins, and to the multiplicity of causes which (owing to their influence upon respiration and cardiac action) tend still further to retard it—such as violent emotions or efforts, and all such diseases as greatly interfere with respiration or with the force and regularity of the heart's action. Ollivier adds that he has often seen in elderly persons fibrinous clots filling the veins of the cord, as well as those which are to be found on its nerve-roots.

Thus one of the common causes of ordinary degenerative softening, as it occurs in the encephalon, would also be operative in the cord.

(10) *White softening* of the spinal cord is, in fact, very common; often implicating its whole transverse area for a variable extent. It differs in no respect in its naked-eye or microscopical appearances from the process as it is met with in the encephalon. It is altogether unreasonable to assume, in accordance with current nomenclature, that this condition is mostly a result of inflammation, and therefore to be spoken of as a *myelitis*, when the pathologists of our time have declared that the similar process in the cerebrum and cerebellum is mostly of degenerative origin.

(11) *Myelitis.*—The writer is, of course, far from denying that primary *inflammation* may involve areas of the cord, and entail 'softening' of its substance. He believes, however, that 'acute myelitis' is far more likely to occur as a secondary process, in connexion with pressure upon and consequent irritation of some part of the cord, encroached upon by fractures or dislocations of the vertebræ, or otherwise wounded; also as an occasional sequela of scrofulous vertebral caries, of the direct pressure made upon the cord by some meningeal tumour, or of hæmorrhage into its substance. The question rather is as to the causation of primary or idiopathic softening—whether this is, in accordance with common phraseology, to be ascribed to inflammation, or whether it is non-inflammatory and of thrombotic origin, as the writer believes. Yet he is also far from believing that *all* the secondary softenings met with in the spinal cord are necessarily of inflammatory origin. Many of these also are probably due to degenerative changes from pressure and thrombosis, rather than to inflammatory causes.

Processes of degenerative 'softening' are mostly brought about quickly, so that they would from a clinical point of view, in the main, correspond with what is commonly spoken of as 'acute myelitis.' As for 'chronic myelitis' (in the commonly understood sense of chronic softening), the writer believes that no such disease should be any longer described. Many 'softenings' are in a certain sense chronic, as, though they may be more or less abrupt in their onset, they tend to last long rather than to kill quickly. Again, other maladies which the older physicians would have ascribed to 'chronic myelitis' or 'chronic softening,' are now known to partake more of the nature of chronic indurations, and to have as their bases various processes of sclerosis.

(12) Processes of *sclerosis* are extremely common in the spinal cord. In nature they are overgrowths of the connective tissue of this organ, altogether similar to those occurring in other organs and tissues, under the name of 'fibroid substitutions' or 'non-inflammatory hyperplasias of connective tissue.' Yet here, again, certain pathologists would have us see results of inflammation, and they accordingly speak of such changes as examples of 'chronic myelitis.' Sclerosis occurs under various forms, and constitutes the basis of several distinct diseases, which are in all cases gradual and more or less slow in their onset, as well as in their progress. It may occur (*a*) as a *diffuse* general overgrowth (after the manner of a cirrhosis in other organs); (*b*) in the form of *fasciculi* or bands limited to particular columns of the cord (especially the posterior and the lateral); or (*c*) in an *insular* manner, so as to form islets of sclerosis, scattered altogether irregularly through the cord at different levels, as in 'disseminated sclerosis.'

(13) Tissue-changes allied to these in their results or later stages, though they have a peculiar history and course of their own at the commencement, are the so-called '*secondary degenerations*' which occur in certain regions of the cord, as a result either of some previous damage or injury to this organ itself, or as a sequence of brain-disease.

These 'secondary degenerations' illustrate facts originally made known by Waller, but which were confirmed and extended by Phillipeaux and Vulpian, to the effect that when nerve-fibres are severed from the ganglion-cells from which they are outgrowths, the white substance of Schwann gradually breaks up in the course of seven to fourteen days, and undergoes a process of fatty degeneration, by which it is ultimately resolved into a multitude of mere molecules and fat-particles. The white columns of the cord are composed of aggregations of nerve-fibres running parallel with one another, so that when one of these columns is cut across, or when the continuity of its fibres is interrupted by some severe lesion occurring in their midst, a process of 'secondary degeneration' manifests itself simultaneously in all the fibres thus damaged, extending upwards or downwards from the lesion according as the fibres cut across have afferent or efferent functions. Thus the result appears as one or more band-like tracts of degeneration, running upwards or downwards according to the extent and situation of the transverse area of the cord affected.

In order to deal as briefly with this subject as possible, it may be said that experience has hitherto shown that such band-like tracts of 'secondary degeneration' occur especially in each lateral half of the cord, in three situations, namely, (1) in the lateral columns; (2) in the inner portions of the anterior columns; and (3) in the posterior columns. The degenerations in the anterior and in the posterior and median portions of the lateral columns take place in a direction downwards from the site of section or lesion of the fibres, at whatever level the damage may chance to exist; whilst those in the posterior columns and in the superficial portions of the lateral columns take place in an upward direction, starting from the section or seat of destructive lesion by which these columns may be invaded.

The fibres that undergo the *descending degeneration* in the lateral columns (constituting the 'crossed pyramidal tract') are generally believed to be those which transmit volitional stimuli to the various voluntary muscles of the body, and which have been previously alluded to as coming into relation with motor cells in the anterior cornua at different levels. These different fibres are supposed to enter the lateral columns at the commencement of the spinal cord, passing into them, in fact, as a result of the 'decussation of the pyramids.' Thus, the motor tract continued downwards through the 'internal capsule' from one Rolandic area of the cortex, let us say the *left*, continues along the crus and through the pons on the same side; thence passing into the bulb a considerable proportion of its fibres decussate with their fellows, and thereby reach the right lateral column of the cord, down which they proceed as a compact group in the manner indicated. The remainder of the fibres of the left motor tract (those which do not decussate) pass down also in a compact body (the 'direct pyramidal tract') and occupy most of the inner half of the left anterior column.[1] Thus, if the whole of the left motor tract be seriously damaged or cut across in the internal capsule or at any point above the 'decussation of the pyramids,' we should have a small band of degeneration in the anterior column on the same side, and also a larger band of degeneration in the opposite (or right) lateral column (fig. 153, H)—that is, we should have the form of secondary degeneration associated with many cases of hemiplegia. But if there be complete section of or destructive disease involving the antero-lateral columns of one side of the cord itself, then we should have a band of degeneration in the anterior, as well as in the lateral, column of the same half of the cord. Or if either column be cut or damaged singly, then in such column a band of degeneration would be found extending downwards from the seat of lesion

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[1] Though this is the rule, yet it would appear from the observations of Flechsig that developmental anomalies are apt to occur, so that the relative proportion between the decussating and the non-decussating fibres is subject to much variation in different individuals.

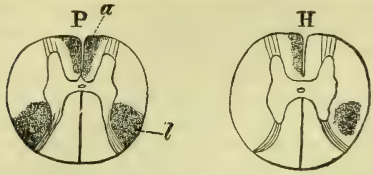

Fig. 153.—*P.* Showing descending areas of degeneration: *a.* in inner part of anterior columns; *l.* in lateral columns (mid-dorsal region). Case of *paraplegia*, from complete transverse softening in upper dorsal region.
H. Showing descending degenerations in case of *right hemiplegia*, from extensive softening of left 'internal capsule.' (Twice natural size.)

Or if, as so frequently happens, we have to do with a total transverse lesion, represented, for instance, by a focus of softening extending through the whole thickness of the cord in the upper dorsal or in some other region (so that the patient suffers from complete paraplegia), we should then find large areas of secondary degeneration in each lateral column below, as well as smaller areas in the inner part of each anterior column (fig. 153, P). The areas in both situations become less extensive as they descend, and gradually wear themselves out in the lower part of the lumbar swelling (see *Med.-Chir. Trans.* vol. l. pl. x.) It was stated by Bouchard, and has been commonly repeated by succeeding writers, that the areas in the anterior columns do not appear beyond the mid-dorsal region; but this mode of termination, as the writer pointed out in 1867, is certainly not invariable.

In such a case as that last cited, namely, one of paraplegia due to a total transverse lesion in the upper dorsal region, there would be found above the seat of lesion certain *ascending degenerations*—the principal of which would be situated in the posterior columns, though others, smaller and more recently defined, are to be met with in the outer part of the lateral columns (fig. 154).

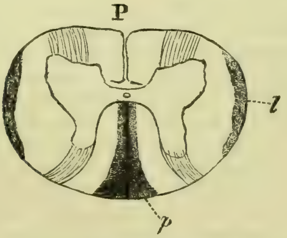

Fig. 154.—*P.* Showing ascending areas of degeneration; *p*, in columns of Goll; and *l*, along outer border of lateral columns, in middle of cervical swelling (corresponding with 'direct cerebellar tract' and the 'tract of Gowers'). Case of *paraplegia*, from complete transverse softening in upper dorsal region.

The ascending degenerations in the posterior columns are often strictly limited to the so-called 'columns of Goll.' Situated on each side of the posterior median fissure, they together constitute a median wedge-shaped patch, whose apex extends forwards to the commissure, and whose base is at the posterior surface of the cord. This band of degeneration reaches upwards to the bulb, where its fibres seem to terminate in the nucleus gracilis.

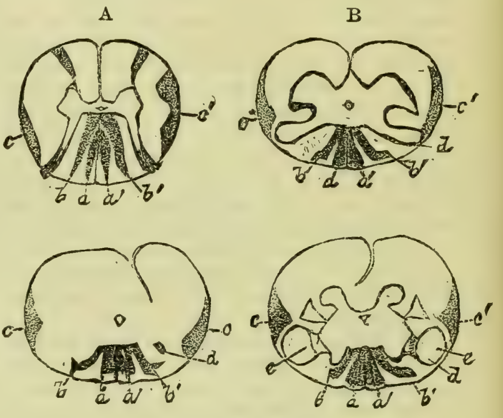

Fig. 155.—Peculiar areas of ascending degeneration, met with in a concussion-lesion of the Spinal Cord.
A, transverse section of the Spinal Cord, near the middle of the cervical region; B, transverse section through the cervical region of the cord, near lower border of medulla; C, section through lower part of medulla oblongata; D, section through Medulla about $\frac{1}{4}''$ below the *Calamus Scriptorius.*
The areas in the posterior columns (*a*, *a′*, *b*, *b′*) have a very peculiar disposition. The areas in the lateral columns in A are very unsymmetrical, that of the right side, anterior to *c′*, represents the lateral sensory tract. Higher sections through the Medulla are represented in *Med.-Chir. Trans.*, 1867, pl. ix.

It seems clear, however, that, under certain conditions, the areas of ascending degeneration in the posterior columns may be differently arranged, and not completely limited to the 'columns of Goll,' since in a case with a lesion of some kind in the mid-cervical region (whose nature is not known, because, unfortunately, this part of the cord was not preserved) the writer long ago found such areas as are represented in fig. 155, in the upper cervical region and in the medulla. The ascending areas of degeneration occupying the superficial portions of the lateral columns were traced by the writer upwards into the restiform bodies. These are areas which we now know to correspond with the subsequently described 'direct cerebellar tract'; whilst the 'tract of Gowers'—corresponding with the part of the areas anterior to *c′* in fig. 155, A and B—which has still more recently been described, also contains afferent fibres for the cerebellum, though they reach it by a different route. According to Schäfer, they can be traced upwards into the bulb and pons Varolii, while they eventually enter the cerebellum as part of the superior peduncle, passing mainly to the vermis. The fibres of this latter tract are intermingled with those of a part of the descending cerebellar tract (fig. 152), which is the only other long tract of degeneration existing in the spinal cord that has not hitherto been mentioned.

In these areas of degeneration, in addition to the changes already mentioned as occurring in the nerves themselves, other processes take place. There is, for instance, a very distinct but secondary overgrowth of the connective tissue throughout the diseased area, as well as an abundant development of large granulation-corpuscles, precisely similar to those met with in ordinary foci of softened nerve-tissue. The granulation-corpuscles are closely packed amongst the meshes of the connective-tissue overgrowth and the atrophied nerve-fibres (*see* fig. 156).

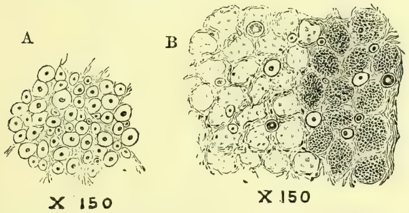

Fig. 156.—A, section of part of lateral column of a healthy Spinal Cord (× 150).

A, appearance of healthy lateral column. B, section through a patch of secondary degeneration in the lateral column of the Spinal Cord, on the right side of which there is shown the appearance of a section mounted in glycerine, and on the left side the appearance of a section mounted in Canada balsam (× 150).

In preparations which have been immersed in bichromates or in chromic acid, these corpuscles do not become stained to anything like the same extent as the healthy nerve-tissues; hence the areas containing them remain pale, and are consequently to be traced with the greatest ease in spinal cords which have been immersed for a week or two in these fluids, though when they were in the fresh state no such areas may have been detectable, even on the most careful examination, by the naked eye. On the other hand, when sections through such degenerated areas of spinal cord are mounted in the ordinary way in Canada balsam, the granulation-corpuscles become invisible, so that Dr. Tooth and other recent writers make no mention of the existence of granulation-corpuscles in the areas of degeneration—the most obvious change then being the overgrowth of connective tissue, leaving, as Dr. Tooth says, 'loculi filled with homogeneous material not staining by Weigert hæmatoxylin.' (*See* his work '*Secondary Degeneration of the Spinal Cord*,' 1889, fig. 6). This 'homogeneous material' in the loculi represents, as the writer believes, granulation-corpuscles altered by the mounting in balsam.

(14) *New-growths* in the substance of the spinal cord itself are not very common, nor, on account of the limitations of space within the spinal canal, do they ever attain a very large size, so long as they take the form of circumscribed growths. For this situation a growth equalling a hazel-nut in bulk would be esteemed large. In regard to the nature of the growth, this is, of course, a matter of purely pathological interest, since the clinical signs and symptoms which a growth in the spinal cord is capable of causing would not vary with its nature, but would be wholly dependent upon its situation, and its rate and manner of increase. *Cancer* occurs within the spinal cord almost solely as a secondary extension from a similar growth pre-existing in the dura mater or in the vertebræ, or possibly in more distant parts. In altogether exceptional cases it may occur primarily in the spinal cord. *Gliomata*, *sarcomata*, and *myxomata* may also occasionally be met with, either in pure or in blended types; and in the case of the former we may have infiltrating growths occupying a wide area in the central and posterior regions of the cord more especially, through a considerable portion of its length, such as occurs in 'syringomyelia.' *Tubercular* or *scrofulous* nodules are also apt to occur, either alone or in combination with a tubercular meningitis. *Syphilitic gummata* may likewise be found in the substance of the cord, though their presence in this situation is not so frequent as it is in association with the spinal meninges.

(15) *Atrophy with degeneration of ganglion-cells* is apt to occur as a secondary process with extreme frequency in portions of the grey matter of the cord which happen to be more or less implicated by other contiguous pathological changes. But in two or three distinct diseases the ganglion-cells of the anterior cornua in different parts of the cord are prone to be suddenly overtaken by an ætiologically obscure and very inexplicable failure of nutrition, commonly supposed to be of an inflammatory nature, which speedily entails an atrophy of the particular cells affected. This, for instance, occurs as the anatomical basis of 'infantile paralysis,' and of the similar form of paralysis now known to occur (though more rarely) in adults. In these diseases whole groups of contiguous and functionally related cells are affected simultaneously, and as the atrophy of the ganglion-cells progresses there is generally evidence of a secondary overgrowth of the surrounding neuroglia in the anterior cornua. To assume that this process is inflammatory in type, as the terms 'cornual

myelitis' or 'acute anterior polio-myelitis' imply, seems to the writer somewhat questionable. Inflammation does not commonly limit itself to individual tissue-elements, and the slight overgrowth of the contiguous neuroglia may well be a secondary process of simple hyperplasia. This latter process is indeed less evident where, as in 'progressive muscular atrophy,' the initial and mysterious atrophy of individual ganglion-cells occurs more slowly and more sparsely. Cells, here and there, in particular anatomical groups, undergo in this affection the atrophic process, leaving others around them for a time as healthy as ever. Yet, as the disease progresses, the ranks of the healthy cells become gradually thinned in an altogether irregular manner; and this atrophy of nerve-cells, as it occurs, speedily entails, for reasons to be set forth in the next section, a corresponding atrophy of functionally related muscular fibres.

§ 6. **Trophic Relations between different Tissues and different Parts of the Spinal Cord.**—Irritation of the posterior cornua, or of the posterior roots of the spinal nerves, may give rise to various pustular or vesicular eruptions in related portions of the skin, often associated with neuralgic pains in these same regions. In other cases, with lesions in some parts of the grey matter, ulceration or actual sloughing of certain related tracts of skin are easily determined—especially under the combined influence of continued external pressure and frequent irritation from urine or fæces, as in some cases of paraplegia.

Degeneration or destruction in any way of the great ganglion-cells of the anterior cornua, or of the anterior roots of the spinal nerves (either within or outside the cord), gives rise, in the course of two or three weeks, to atrophy of the muscle-fibres with which such atrophied cells or nerve-roots are in relation. We thus get an atrophic paralysis, associated with the electrical 'reaction of degeneration.'

Certain diseases affecting the grey matter of the cord (in ways and sites which cannot be precisely defined) are also commonly supposed to be associated with chronic diseases of the joints; it seems, however, to the writer that these articular changes may be due rather to a co-existing peripheral neuritis involving certain nerves proceeding to the joints. Sometimes comparatively unimportant, these joint-changes lead in other instances to great atrophy of the articular ends of the bones, and possibly to dislocation with utter destruction of the joint, as in some cases of locomotor ataxy. Atrophy, with brittleness of bones, may also be met with in the same or in allied cases.

The fact of the existence of these trophic troubles in association with such lesions may be admitted wholly irrespective of the explanation of their pathogenesis. Whether they are due to defective or altered influences transmitted by ordinary motor and sensory nerves in relation with such tissues, or to altered influences through certain purely hypothetical 'trophic nerves,' lies altogether outside the fact of the mere co-existence of the several trophic troubles with the several lesions—which is the point of more immediate interest for the practitioner of medicine.

§ 7. **General Symptomatology, and General and Regional Diagnosis.**—Taking them in conjunction with some of the simpler principles of nerve-physiology, the practitioner has to make use of the various kinds of data above enumerated in the investigation of the precise nature of every case of disease of the spinal cord which comes before him. Under the word 'nature' we include, of course, both sides of the diagnosis that has to be made, namely, the *regional* and the *pathological*.

The practitioner is compelled to interpret the patient's symptoms, and the various signs he is able to recognise for himself, by the aid of such data when he attempts, for instance, to ascertain what parts of the cord are damaged, and in what order they have been implicated. He may wish to know whether the posterior or the lateral columns are specially involved; whether the grey matter is much damaged; and, if so, whether the damage more particularly affects the anterior cornua or other parts. Again, he may wish to know whether the anterior or the posterior spinal nerve-roots are specially involved; and, if so, whether they are merely irritated or more severely damaged, and whether they have been simultaneously or successively affected. For the present we shall concern ourselves with this aspect of the problem only, though it will subsequently be shown in our account of the several diseases of the spinal cord what light the co-existence of certain groups of these facts throws upon the other aspect of the problem, namely, upon the question of the pathological nature of the lesion.

Some of the facts already cited have, however, to be translated into their clinical equivalents, and to be supplemented by others derived more exclusively from the clinico-pathological study of spinal diseases, in order to form a series of data more immediately useful in the interpretation of the phenomena of diseases of the spinal cord in their regional relations.

Regional Diagnosis.—We already possess a number of valuable clinical data available for throwing light upon the regional side of the problem of diagnosis. It must be borne in mind, however, that the regional diagnosis of diseases of the spinal cord is itself a twofold problem. It involves a consideration: (*a*) of the *transverse area* involved; and (*b*) of the *longitudinal situation and extent* of the disease in such areas.

(*a*) DIAGNOSIS OF THE TRANSVERSE AREA INVOLVED.—The facts to be tabulated under this head may be set down in the order of their relation to different component parts or regions of the spinal cord.

(1) *Anterior roots of spinal nerves.*—Irritation of these may give rise to various forms of twitching or to tonic spasms in related muscles. Great pressure upon or destruction of the anterior roots will give rise to local complete or partial paralysis in the related muscles, followed in the course of a week or two by marked atrophy, and the establishment of the electrical 'reaction of degeneration' (*see* PARALYSIS). There will also be an abolition of reflex excitability of these muscles in response to skin-irritation, or from blows upon or stretchings of their tendons.

(2) *Antero-lateral columns.* — Increasing pressure upon or disease of these columns gives rise to paresis, gradually deepening into motor paralysis of parts deriving their nerve-supply at or below the seat of lesion.

When the disease occurs in the lateral column more especially, there may be twitchings or startings in the muscles below, or well-marked spasms, and possibly painful cramps. There may also be great exaltation of the superficial and deep reflexes, if the manifestation of the latter is not hindered by pre-existing spasms. Motor paralysis exists to some extent, but without any appreciable impairment of sensibility. No marked wasting of muscles, or diminution in electrical reactions, usually occurs.

(3) *Grey matter.*—(*a*) *Of anterior cornua.* Disease of these parts causes motor paralysis, with atrophy, loss of faradic excitability and of reflex excitability in related muscles—as in cases of disease of the anterior roots of spinal nerves.

(*β*) *Of posterior cornua and central parts.* Damage of these regions of grey matter will, according to its completeness in transverse extent, cause more or less delay or defect in the transmission of painful and thermic impressions, and perhaps interfere also with other modes of sensibility.

Some trophic lesions in skin and joints may also be met with (*see* § 6).

⁂ At different levels in the cord special centres (represented in both anterior and posterior regions of grey matter) in connexion with definite functions, may be interfered with by morbid conditions implicating the grey matter (*see below*, (*b*) [1–10]).

(4) *Posterior columns.*—The results of disease confined to this situation (more especially to the 'root-zones') will be—ataxy or signs of incoördination of movements; interference with impressions of touch, pressure, temperature, and of 'muscular sense'; abolition of knee-reflex; and diminution or loss of sexual desire.

(5) *Posterior roots of spinal nerves.*—From irritating lesions there will arise lancinating or other pains in the skin and deeper textures of related portions of the limbs, and possibly trophic skin-lesions. Pressure or destructive lesions will give rise to loss, in various degrees, of different modes of sensibility, superficial and deep; and diminution or abolition of the superficial and deep reflexes in related regions of the body.

It has been shown by Sherrington and others that there is considerable overlapping of the skin-areas supplied by contiguous posterior roots, and this has recently been well exemplified in one of the writer's cases of spinal caries operated upon by V. Horsley. In the course of the operation a single posterior nerve-root in the mid-dorsal region was divided on the right side, whilst two nerve-roots were divided on the left side. Around this latter half of the body a narrow band of anæsthesia was produced, only one inch wide; whilst on the right side there was no anæsthesia, this being obviated apparently by the overlapping above referred to. No such overlapping exists, however, in connexion with the territories of the nerves concerned with the appreciation of heat or cold, or of painful impressions (Head).

(*b*) DIAGNOSIS OF THE LONGITUDINAL SITUATION AND EXTENT OF THE LESION.—This is a consideration distinctly secondary to the other, since, at whatever longitudinal level the disease may be situated, its clinical characters will always be qualified by the part or parts of the transverse extent of the cord that may be involved. Here we are accustomed to obtain information of a general kind from the fact (1) that *special centres* in connexion with different viscera and functions, situated at different longitudinal levels in the cord, may be more or less deranged. But we have to depend in the main (2) upon the signs indicative of the *implication of particular sensory and motor nerves*, whose exact relations with different portions of the spinal cord are known. Such signs may consist of some excess or defect of *sensibility*, of *motility*, or of *reflex action.* Again, where disease or injury of the vertebræ exists in association with disease of the spinal cord, we may be guided by the known relations of the different vertebral spines to the different nerve-roots and segments of the cord.

Evidence from perverted activity of Spinal Centres.

(1) The lateral columns in the upper cervical region contain the motor paths for the muscles of respiration, so that section or disease of these columns at a lower level may interfere with the movements of respiration on the same side of the chest (thoracic muscles); whilst, if the lesion reaches as high as the fourth and third cervical nerves

(the origin of the phrenic) the diaphragm itself also becomes paralysed, and the movements of respiration must therefore almost cease.

(2) Again, the upper cervical region of the cord, though it does not contain actual centres connected with the excitation of the heart's action, is traversed by the augmentor and accelerator nerves, whose point of exit from the cord, as white *rami viscerales*, is with the second, third, and other upper dorsal anterior roots. These nerves ascend to the stellate ganglion, and thence proceed to the heart.

Thus different lesions in this upper cervical region of the cord may, according to their nature and extent, greatly interfere with the heart's action, as well as with the respiratory movements. The frequency of the pulse may be either notably accelerated or retarded; whilst the respiratory movements may be slower or much quicker than natural, and also extremely irregular and perverted in rhythm.

(3) The lower cervical and upper dorsal regions of the cord also contain the so-called 'cilio-spinal centre.' The fibres emanating from it pass outwards with the fibres of the anterior roots in the first, second, and third dorsal nerves (but especially in the second), and thence into the cervical sympathetic. Irritation of them causes dilatation of the pupil on the same side, together with widening of the palpebral fissure, whilst section or other destructive lesion of these parts causes contraction of the pupil.

(4) The vaso-motor nerves for the side of the head and neck, the pinna of the ear, together with the lateral lobe and half the isthmus of the thyroid body arise in similar regions of the cord, and also leave it similarly. Irritation of them produces contraction of the blood-vessels, and a lowering of temperature of the side of the face and head, together with diminution of sensibility, an absence of perspiration, and (should the irritation continue) a tendency to slight atrophy of the corresponding side of the face. Destructive lesions, on the other hand, operating upon these vaso-motor fibres, tend to produce a reverse set of conditions. *See* SYMPATHETIC SYSTEM, Disorders of.

Sometimes there may be signs of paralysis of oculo-pupillary fibres co-existing with signs of irritation of the vaso-motor fibres, or *vice versâ*.

(5) Gaskell has shown (*Journ. of Physiol.* vol. vii.) that all the *vaso-motor nerves* of the body leave the spinal cord in the anterior roots of the spinal nerves, from the second dorsal to the second lumbar inclusive, passing thence into the lateral ganglia of the sympathetic, in which these vaso-motor fibres lose their medullary sheaths. He adds (*loc. cit.* p. 15): 'This chain might, therefore, most appropriately be called the chain of vaso-motor ganglia instead of its present meaningless title of main sympathetic chain.' Gaskell also thinks, and in this he is supported by Sherrington, that the vaso-motor nerves, as well as certain visceral motor nerves, are connected with ganglion cells in the lateral regions of the grey matter (fig. 86).

Generally it may be said that section of one half of the cord or destruction of it for any extent longitudinally, causes at first paralysis of blood-vessels in the lower parts of the body on the same side—this vaso-motor paralysis carrying with it in the same parts an increase of temperature and an exaltation of sensibility. In a short time, however, the vaso-motor paralysis (and with it the increase of heat and sensibility) passes away, owing to the vaso-motor centres in parts of the spinal cord below, and to the peripheral vaso-motor centres, adapting themselves to act independently of those in higher parts of the cord, and of the supreme regulating centre in the medulla oblongata. (As a rule, the higher vaso-motor centres control those lower down, but after temporary paralysis even the peripheral vaso-motor centres seem to resume control over related blood-vessels.)

(6) The movements and secretions of the stomach and intestines generally are certainly influenced by the cord in different regions, so that in various cases, under perversions of this normal spinal influence, we may get vomiting, diarrhœa, or obstinate constipation—as direct results, that is, of morbid changes in certain parts of the cord in which intestinal sympathetic fibres have their roots. It seems, however, that through the greater portion of the alimentary canal the circular muscles are innervated by motor fibres distributed with the vagus. Thus peristaltic contractions of the œsophagus, stomach, and intestines can be excited by vagus stimulation, whether the stimulus be applied to the roots of the nerves as they leave the bulb, or to the main trunk of the vagus in any part of its cervical or thoracic course. On the other hand, the circular fibres of the rectum and of the descending colon are supplied by the lower abdominal splanchnic nerves, which leave the cord with the thoracic and not with the sacral outflow of visceral nerves (Gaskell).

In the grey matter of the lumbar swelling of the cord there are aggregated a number of *centres* having to do with important functions, which may be variously interfered with by disease. These centres are those which regulate—(7) the evacuation of the rectum; (8) the evacuation of the bladder; (9) erection, and ejaculatio seminis; and (10) the contractions of the uterus.

In each case the spinal centre constitutes an independent reflex centre, provided with its afferent and efferent nerves, but in each case also there is more or less of connexion between the spinal centre and others in the cerebral hemispheres. There must therefore be double sets of fibres for each centre traversing the whole length of the spinal cord and medulla; partly (commissural) for the transference of afferent impressions from each spinal centre to the brain, and partly (internuncial) for the conduction of efferent impressions from cerebral kinæsthetic to spinal motor centres.

In the case of the uterine centre these cerebral connexions are of comparatively slight importance; since, with a complete transverse lesion in the cervical or even in the upper dorsal region, the process of parturition may still be successfully accomplished. So long as the spinal mechanism is complete and perfect, parturition may take place without the need of cerebral co-operation. Our subsequent remarks will, therefore, refer principally to the other three lumbar centres.

Complete transverse lesions occurring in any part of the dorsal or cervical regions will, of course, entirely cut off all the above-mentioned lumbar spinal centres from connexion with, and therefore from any voluntary control by, the cerebral hemispheres. But various limited local lesions in particular transverse areas of the cord (though such areas cannot at present be definitely specified) may produce similar results, so far as the cerebral control of any one or two of the lumbar centres is concerned. According as the severance of these lumbar spinal centres from cerebral correlation and control is complete or partial, one or other of the following results would be produced:—

Name of Centre	Complete Severance from Cerebrum	Incomplete Severance from Cerebrum	
	Afferent and Efferent Fibres	Afferent Commissural Fibres only	Efferent Internuncial Fibres only
Rectal centre . .	Unconsciousness of need, and inability to prevent evacuation *Result.*—Constipation, with incontinence of fæces after an aperient	Unconsciousness of need, and therefore no attempt to restrain evacuation	Consciousness of need to evacuate, with no ability to restrain the act
Vesical centre . .	Unconsciousness of need, and inability to prevent micturition *Result.*—Reflex evacuation in gushes at intervals	Unconsciousness of need, and therefore no attempt to restrain micturition	Consciousness of need, but inability to restrain micturition
Sexual centre . .	Diminution or absence of sexual desire. Erections and emissions, if they occur, wholly dependent upon the spinal reflex mechanism	With simple destruction of fibres, nearly same results as set down in previous column; but with *irritation* of afferent fibres there might be great increase of desire (satyriasis or nymphomania)	Feelings of desire, but no erection in response Erection and emissions, if present, purely through spinal reflex But with *irritation* of efferent fibres there may be persistent erections, mostly without desire

The *rectal* and the *vesical spinal centres* are each composed of two parts, with their separate afferent and efferent nerves—one set in relation with a sphincter muscle, and the other in relation with detrusor or expulsive muscles in functional opposition with the former. The several nerve-fibres, both afferent and efferent, in connexion with these centres have been shown by Sherrington (*loc. cit.* sec. iii., p. 672) to be contained in the first four sacral nerves, and in the case of the bladder also in the third, fourth, and fifth lumbar nerves (though none are contained in the intervening sixth and seventh lumbar). Thus, as Sherrington says (p. 683): 'If, as one may suppose, the position of the outflow of the efferents fairly indicates the position of the nucleus whence they come, then we may suppose that a long nucleus for the bladder exists in the lumbo-sacral region, which has, however, a gap in its continuity. . . . The outflow from the anterior roots above the gap is into the sympathetic system; from the anterior roots below the gap is direct by the sacral nerves.' Destruction or irritation of either of these sets of fibres, or of one of the centres, will necessarily interfere to some extent with the working of this particular centre, so that its functions may be interfered with in several different ways. There may be various degrees of irritability of the bladder or rectum, or various degrees of paralysis of these organs.

In cases of paralysis of the bladder, especially when owing to lesions implicating its spinal centre, the urine is apt soon to become fœtid and alkaline, and inflammation (alone or with ulceration) is most prone to be set up in its mucous membrane.

The details as to the modes of disturbance of the *genital* function, where disease implicates its lumbar centre or the afferent and efferent nerves in connexion therewith, are less known than where it involves the communicating fibres between this centre and the cerebrum. The *nervi erigentes* have been shown to pass out with the second and third sacral nerves, so that the sexual like the rectal centre is contained in the posterior part of the lumbar swelling. In the female the uterine centre has been shown to be similarly situated.

Evidence from implication of particular Sensory or Motor Nerves.

The more precise indications concerning the longitudinal implication of the spinal cord are, as already stated, derivable from the level at which alterations in sensibility or in motility (either voluntary or reflex) are to be detected. The more closely the lesion approaches to what is called a 'total transverse lesion,' the more distinctly will signs of this order reveal themselves. It is important, too, to recollect that the fibres of different sensory roots are to some extent dispersed through cutaneous surfaces overlying the muscles supplied by the corresponding motor roots. There are, however, many exceptions to this.

In regard to *sensibility*, the upper limit at which the trunk is affected is often sharply defined by the presence of a feeling of constriction, of pain, or of numbness ('girdle sensation') encircling the body. This sensation is generally supposed to be due to irritation of the roots of the nerves as they traverse the posterior columns (or perhaps outside them) at the upper level of the lesion. This symptom may of course be absent, but in some cases of paraplegia it is well-marked, especially where the upper level of the lesion lies anywhere between the third and the twelfth dorsal nerve-roots.

Our knowledge has of late been greatly increased concerning the extent and distribution of the cutaneous areas ('segmental skin-fields') pertaining to each sensory spinal nerve, owing to the labours of Ross, Allen Starr, James Mackenzie, Head, and Sherrington. As the latter investigator says (*Proc. of Roy. Soc.*, vol. lii., p. 333): 'Although in a plexus each posterior spinal root gives separate contributions to several nerve-trunks, the cutaneous distribution of the root is composed not of patches which are disjoined, but of patches which are so joined that the distribution of the entire root forms one continuous field. . . . Each segmental skin-field spreads, to a certain extent, across neighbouring segmental skin-fields. . . . The *fore-lap* and the *after-lap* are, throughout the body, very great, and each region of skin appears to be supplied by at least two sensory roots. . . . The shape of a segmental skin-field is, where simplest—*e.g.* in the trunk and neck—band-like, wrapping transversely round one lateral half of the body; it has fairly parallel edges, but is somewhat broader near its vetnral than at its dorsal end. In the limb the segmental skin-fields are *distorted* from the simple band-like type;' and they are also seemingly *dislocated* from their attachments to the mid-dorsal and mid-ventral lines of the trunk. This peculiar distribution Sherrington explains by supposing that the mid-dorsal as well as the mid-ventral line of the body extends outwards in the position of the limb as a side branch or secondary axis (*see* diagram, *loc. cit.*, p. 337). 'Upon these dorsal and ventral side lines, as upon secondary dorsal and ventral axes, the cutaneous segments of the limb are ranged, as though upon folded portions of the axial lines of the trunk itself.'

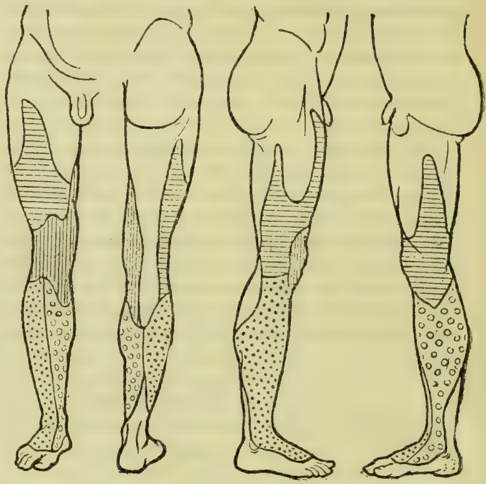

FIG. 157.—To show the presumed distribution of the areas supplied from the 2nd lumbar to the 1st sacral segments.
The area marked in *cross lines* represents L 2.
The area marked in *vertical lines* represents L 3.
The area marked with *circles* represents L 4.
The area marked with *dots* represents L 5.
The area left plain below represents S 1.

Now, as already stated (§ 7, (*a*), (5)), this overlapping of the segmental skin-fields exists, especially for tactile sensations, owing probably to the related tracts of grey matter in the spinal cord extending into the spinal segments above and below its own, and consequently being represented in the corresponding posterior spinal nerve-roots. The researches of Head (*Brain*, pt. lxi., 1893), however, seem to show that no such overlapping of segmental skin-fields or extension of related grey matter into adjacent spinal segments exists for painful impressions, or for those of heat and cold. Consequently, to determine the exact boundaries of a cutaneous area of defective sensibility, whether due to a lesion in the cord or of one or more posterior spinal roots, we shall get much more accurate results if we seek to map out the areas in which the patient may be insensitive to painful impressions, or to those of heat and cold, rather than those areas in which he is insensitive to ordinary tactile impressions. These different areas in relation with the several posterior roots have been definitely mapped out by Head, and the plates accompanying his paper will afford most useful guidance to future investigators seeking to determine the longitudinal level or extent of lesions in the spinal cord or in the posterior roots. The areas are too elaborate to admit of detailed description here; but a supplemental figure, showing the probable skin-fields from the second lumbar to the first sacral inclusive, has been reproduced above (fig. 157). For the rest the plates given by Head must be consulted.

Efforts were also formerly made to define the muscles that were paralysed, in any given case, with a view to determine the upper limit of the lesion in the cord. It was thought that a reference to the anterior roots by which such muscles are innervated ought to enable us to fix upon the particular segment of the cord from which their nerves proceed, and thus to determine with precision the upper level of the lesion in the *motor regions* of the cord.

This is a matter, however, by no means so simple as might be supposed, because the majority of limb and trunk muscles receive fibres from more than one motor root, as Preyer and Krause and others showed long ago. The same conclusion has been arrived at by Eckhardt, and later by Sherrington. The former says: 'A great number of muscles in the limb obtain nerve-fibres each of them from several nerve-roots. Most of the thigh-muscles always, some of the leg-muscles frequently, are supplied by three, the latter more often by two, nerve-roots.' According to Sherrington, when a muscle is supplied by three nerve-roots it is noticeable that the middle root of the three usually causes the most powerful contraction. However this may be, it is obvious that the fibres going to each muscle must take their origin 'over a certain considerable longitudinal region of the cord.'

This fact, that muscles receive their nerve-supply from two or three different nerve-roots, was formerly thought to be due to the circumstance that the same muscle is called into play in different coördinated movements. And the view of E. Remak, that functionally related or synergic muscles are represented together in the anterior horns of the spinal cord, was supposed to have been confirmed and extended by Ferrier and Yeo (*Proc. of Roy. Soc.*, March 24, 1881, p. 12) by their experimental observations on the functions of the anterior roots. They say that stimulation of the individual roots of the brachial and crural plexuses results, not in mere unrelated contractions of various muscles, but in highly coördinated synergic contractions, leading to definite movements. But as the 'muscles thrown into action by each root are innervated in most cases by several nerve-trunks,' the result 'of section of each motor root would therefore be paralysis of the corresponding combination, not necessarily, however, of the individual muscles involved . . . whilst *weakened*, they might yet act in other combinations in so far as they were supplied by other roots.' The different combined movements which they thought to be dependent upon particular motor roots are cited by the authors in this paper.

This important subject has been re-investigated of late by Sherrington (*Journ. of Physiol.* vol. xiii. No. 6, pp. 708–35), who comes to an opposite conclusion. He says: 'Contrary to Panizza's doctrine, revived and ably reappointed by Remak and by Ferrier and Yeo, and followed since by Bert, Marcacci, and others, I believe John Müller to have been right in attributing to the arrangement of the motor roots of the limb-plexus an anatomical significance, based on metamerism, rather than a teleological dependent upon supposed demands of functional coördination.' He considers that in the great majority of cases muscles innervated by the same nerve-root lie adjacent one to another, but 'that the loss of some particular coördinated movement results, from the severance of one of the motor roots of the limb-plexus,' he says, 'I have been unable to detect, and seen no evidence to support.' His own investigations lead him to believe that the section of some two, three, or even more anterior roots going to the upper or lower limb-plexus leads to a weakened condition of many movements. He adds: 'The helplessness, at first very apparent, rapidly diminished up to a certain point. The diminution seemed to be largely due to the overcoming in course of time of an unwillingness to attempt movements with the injured limb.' His experiments with monkeys convinced him that the execution of a coördinated movement was still possible when one motor root only of the plexus remained open as a channel from the cord.

All this shows that the upper level of a lesion in the cord can only be fixed approximately by reference to the motor paralysis existing in limbs or in the trunk of the body.

The integrity of those *reflex* actions which can be elicited either in health or in disease depends, of course, upon the integrity of the entire nervous arcs concerned (that is, upon the integrity of ingoing fibres, centres, and outgoing fibres). Thus, though the impairment of a reflex *may not necessarily* be due to central causes, its presence, on the other hand, clearly shows that the grey matter and other regions of the cord which must be traversed by its stimuli are not impassable: whilst its exaltation will indicate the probable existence of some congestion by which the grey matter in question is rendered more excitable, or else some central change by which it is cut off from cerebral inhibitory influences. In § 4 will be found all the needful indications referable to the presence or absence of reflexes which can be used for the determination of the upper level of a lesion existing in the spinal cord. The lower level of a lesion in this organ is always extremely difficult to determine; and if it is to be made out at all, it must be done by reference to the existence of particular muscular atrophies, rather than from the presence or absence of certain reflexes.

Other data in regard to the longitudinal situation of a lesion in the spinal cord are of a more precise order, and are dependent upon the *relations of the vertebral spines to different anterior nerve-roots.* These data are available in cases where the spinal cord becomes implicated in connexion with primary disease or injury of the vertebræ. To obtain such data, it is needful to know the exact relations subsisting between the bodies of the different vertebræ, their spines, and the origins of the different nerve-roots.

Only the highest cervical nerves arise from the cord opposite the place at which they leave the spinal canal. As we descend, the distance between these two points gradually increases, and it attains its maximum when we come to the nerves of the cauda equina. What nerve-origins correspond, therefore, to a given vertebral level can only be decided by careful anatomical investigation.

A further complication is introduced into this question, seeing that the vertebral spines, which we are compelled to deal with as localising guides, have different relations in different parts of the spinal column to the bodies of their respective vertebræ—*e.g.* they incline downwards in the dorsal region more especially, to a less extent in the cervical, and scarcely at all in the lumbar region.

Some of the principal facts in reference to these two points, namely, (1) the relations of spinous processes to bodies of vertebræ, and (2) the relations of vertebral spines to origins of nerve-roots, will be found to be embodied in the next section.

§ 8. For practical purposes it will be well here to group together the various indications as to longitudinal localisation to which we have referred—classifying them as they are related to one or other of four regions of the spinal cord.

(*a*) **Cervical Region of the Cord.**—*This corresponds externally to the space between the occiput and the upper border of the seventh cervical spine* (*eighth cervical nerve*).

The first, second, and third cervical spinous processes are respectively opposite the origins of the third, fourth, and fifth cervical nerves. The phrenic nerve (motor nerve of the diaphragm) arises from the fourth, or from the third and the fourth cervical nerves. Opposite the third cervical spine (level of fifth cervical nerve) the cervical swelling of the cord begins; whilst it ends opposite the seventh cervical spine (level of first dorsal nerve).

Disease of this region may involve interference with respiration, and possibly weakness of voice; interference with the heart's action—pulse very frequent, or the reverse; flushing or pallor of the head and neck; continued priapism (with crushing lesions); augmentation of temperature in the body generally (hyperpyrexia); and marked contraction or dilatation of the pupil.

The innervation of the shoulder, arm, and hand muscles is derived from spinal nerves between the sixth cervical and first dorsal inclusive; those supplying the ulnar side of the hand and forearm arising from the lower level, that is, from the upper part of the next region. The upper extremities may, therefore, be more or less paralysed, as well as the trunk and lower extremities.

(*b*) **Upper Half of the Dorsal Region of the Cord.**—*This corresponds externally to the space between the seventh cervical spine* (*first dorsal nerve*) *and the fourth dorsal spine* (*sixth dorsal nerve*).

The results of disease here are apt to be these: The 'scapular reflex' may be abolished, calling into activity as it does the last two or three cervical and the first two or three dorsal nerves; the intercostal muscles are paralysed at different levels; a 'girdle sensation' is felt at different levels; there may be prominence of certain vertebral spines, and possibly tenderness on pressure or on tapping over them; the 'epigastric reflex' may be abolished, depending as it does upon the spinal cord at the level of the fourth to the sixth or seventh pairs of dorsal nerves; and priapism (with crushing lesions) may occasionally be met with. We may have, therefore, some or all of these signs together with more or less complete paralysis of the lower part of the trunk and of the lower extremities.

(*c*) **Lower Half of the Dorsal Region of the Cord.**—*This corresponds externally to the space between the upper border of the fifth dorsal spine* (*seventh dorsal nerve*) *and the lower border of the tenth dorsal spine* (*space below twelfth dorsal nerve*).

Disease here may give rise to the following symptoms: The 'abdominal reflex' may be abolished, depending as it does upon the integrity of the cord between the levels of the eighth dorsal and the first lumbar nerves. Paralysis of lower intercostal muscles or of abdominal muscles may possibly occur, in addition to paralysis of the lower extremities. 'Girdle sensation' may be felt at different levels (the umbilicus corresponding with the tenth dorsal nerve, and the 'ensiform area' with the sixth and seventh dorsal nerves). There may be prominence of certain of the lower dorsal spines, with possible tenderness.

(*d*) **Lumbar Region of the Cord.**—*This corresponds externally to the space between the lower border of the tenth dorsal spine* (*just below the twelfth dorsal nerve*) *and the upper border of the second lumbar vertebra.*

Here the symptoms are: Paralysis, not

implicating the abdominal muscles, but limited to more or less of those of the lower extremities. No 'girdle sensations' around the trunk. Three superficial reflexes may be abolished, namely, the 'cremasteric,' which depends upon the integrity of the cord in the upper lumbar region; the 'gluteal' and the 'plantar,' both of which seem to be dependent upon the integrity of the lower part of the lumbar region of the cord. A deep reflex may also be abolished, namely, the so-called 'knee-jerk,' which is dependent upon the upper lumbar region of the cord. 'Ankle-clonus' may be met with when disease affects the upper or mid-lumbar regions of the cord, but not where the lower lumbar region is implicated. Loss of sensibility about the perinæum and anus (if not due to disease of nerve-trunks) is indicative of disease of the posterior columns in the lower lumbar region. Absolute paralysis of the bladder and rectum may be present, with tendency to inflammation and ulceration of the former organ. (With lesions higher up in the cord there may also be, according to their extent, some of the alterations in regard to the action of the bladder and rectum which have been set forth in a table on p. 809.)

In the clinical data above given are included the majority of the facts upon which the *regional diagnosis* of diseases of the spinal cord must in all cases be based. In them also will be found the explanations, so far as they can be given in moderate compass, of the *symptoms* met with in different diseases of the spinal cord. An obvious advantage will be found to have resulted from this somewhat lengthy preliminary discussion, if, as it ought to do, it tends to give the practitioner a more thorough insight into the nature and relations of the several diseases of the spinal cord, at the same time that it aids him in their diagnosis.

Although it is true that the groups of symptoms presented in different diseases of the spinal cord, considered individually and collectively, afford the materials upon which a *regional* diagnosis must be founded, it is no less true that a part of the symptomatology (namely, that comprised in the mode of origin and the mode of establishment of the disease, together with what may be gathered from the patient's state generally, from his family history, and from his personal history) constitutes the basis upon which a *pathological* diagnosis has to be arrived at. Again, although the arrival at a regional diagnosis is often spoken of, and may seem to be a process altogether distinct from that involved in the arrival at a pathological diagnosis, yet, as a matter of fact, in the investigation of many individual cases of spinal disease, it will be found that the one problem is not settled first, and the other afterwards, but that both are tentatively considered more or less simultaneously. Thus, certain empirically known pathological conditions may afford at once a ready explanation of a given group or sequence of symptoms, as in 'infantile paralysis,' in 'locomotor ataxy,' or, in a more general sense, in angular curvature of the spine. Here, therefore, the pathological diagnosis goes hand in hand with the regional diagnosis, and in working them out each gathers additional confirmation from the establishment of the other. Sometimes, however, as in the case of traumatic injuries (including stabs, and fractures with dislocations of vertebræ), the pathological diagnosis is at once obvious, and the regional diagnosis alone requires to be settled in detail.

For the above reasons, it has been necessary to tabulate in this article certain '**Pathological Data concerning the Spinal Cord**' (§ 5), though it would not be found specially advantageous were we to follow out this part of the subject further, and attempt here to set down the more general *clinical data and deductions of pathological import*, necessary to be borne in mind for the arrival at a pathological diagnosis, in order to form a series of facts and deductions comparable with those already given in elucidation of the problems of regional diagnosis (§§ 7 and 8). These other problems will be dealt with, as far as possible, in the descriptions of the several diseases of the spinal cord.

H. CHARLTON BASTIAN.

SPINAL CORD, Special Diseases of.—In order that the mutual relations of the different diseases of the spinal cord may be the more readily appreciated, their names are here set down in groups, and they will be severally considered in the same order, which is one based upon their causes and nature, rather than upon alphabetical considerations. This list will, therefore, in addition, serve as an index to the order in which the several diseases of the spinal cord are described. The names of the different diseases now to be described are in this list printed in ordinary Roman type; while the names of those diseases that are discussed separately in different parts of the work (to which descriptions the reader is referred) are printed in small capitals.

I. Diseases of the Spinal Cord dependent upon known organic changes:—

(1) Spinal Cord, Concussion of; (2) Spinal Cord, Punctured or Gunshot Wounds of; (3) Spinal Cord, Sudden Crushing Lesions of; (4) Spinal Cord, Slow Compression of; (5) Spinal Cord, Anæmia of; (6) Spinal Cord, Hyperæmia of; (7) Spinal Cord, Inflammation of; (8) Spinal Cord, Hæmorrhage into; (9) Spinal Cord, Softening of.

(10) INFANTILE PARALYSIS; (11) Acute Spinal Paralysis of Adults; (12) Acute

Ascending Paralysis; (13) Chronic Spinal Paralysis; (14) PROGRESSIVE MUSCULAR ATROPHY.

(15) LOCOMOTOR ATAXY; (16) Spasmodic Spinal Paralysis; (17) Amyotrophic Lateral Sclerosis; (18) Multiple or Disseminated Sclerosis; (19) Friedreich's Disease.

(20) Tumours and New Formations of the Spinal Cord; (21) Syringomyelia; and (22) Malformations of the Spinal Cord.

II. Diseases dependent upon unknown or imperfectly known organic changes:—

(23) TETANUS; (24) TETANY; (25) TORTICOLLIS; (26) WRITER'S CRAMP; (27) SPINAL IRRITATION; (28) Reflex Paraplegia; (29) Intermittent Paraplegia; (30) Functional Paralysis of Spinal Type; (31) Paraplegia dependent on Idea; (32) Neurasthenia Spinalis; and (33) Toxic Spinal Paralysis.

In addition to these diseases, dependent upon changes limited to the spinal cord, other affections should here be mentioned, in which the spinal cord is implicated (in modes more or less known) together with the cerebrum in one or other of its regions. These *cerebro-spinal* affections are as follows: (1) GENERAL PARALYSIS OF THE INSANE; (2) CEREBRO-SPINAL SCLEROSIS; (3) PARALYSIS AGITANS; (4) HYDROPHOBIA; and (5) CHOREA.

For an account of the diseases dependent upon morbid changes in the membranes of the spinal cord, *see* MENINGES, SPINAL, Diseases of.

1. Spinal Cord, Concussion of.—SYNON.: *Commotio Medullæ Spinalis*; Fr. *Commotion de la Moelle Épinière*; Ger. *Erschütterung des Rückenmarks.*

ÆTIOLOGY.—This condition is met with principally in persons who have fallen from a height, or in those who have been present in a railway collision. In these cases the brain is apt to suffer as well as the spinal cord, and it is not always easy to unravel the respective symptoms due to shock of this or that great segment of the cerebro-spinal system.

ANATOMICAL CHARACTERS. — In many of these cases there are, in all probability, no morbid changes that would be discoverable. In others, however, minute extravasations of blood, or actual ruptures of the nerve-tissue, may occur. Sometimes, as in a case seen by the writer, even notable lesions are produced. An example of the slighter lesions is recorded by the late Sir William Gull, in which small extravasations of blood were found in the anterior and posterior cornua, as well as in the posterior columns of the cord. In neither of these cases was there any external or visible injury; but in each paraplegia was produced immediately after the fall that determined the lesions in the cord. In addition to hæmorrhages into the substance of the spinal cord itself, there is in these cases the possibility of the occurrence of meningeal hæmorrhages, pressing upon the cord or its nerve-roots; and within a day or two after the occurrence of the concussion itself, there is the possibility of some local and subacute inflammation being set up in the membranes of the cord.

SYMPTOMS.—In the great majority of these cases no complete paralysis is induced, even at first. There may at most be paresis of one or more limbs, general prostration, nausea with occasional vomiting, a rapid and possibly irregular or intermittent pulse (especially after the least exertion), with occasional startings and twitchings of the limbs, the sensibility of which may be diminished, exalted, or unaffected. The temperature will probably be at first depressed, as a result of shock, though subsequently a slight febrile elevation may continue for some days. The tongue may be furred, the appetite bad, the bowels constipated; whilst in regard to micturition there may be either some delay and difficulty, or, on the contrary, an irritability of the bladder, with difficulty in retaining its contents after the desire to micturate is once felt. With this there is often general restlessness, nervousness, and insomnia.

In more severe cases of concussion, even where there is no complication resulting from appreciable lesions, the shock to the system (*see* SHOCK) may be more profound, and there may be paralysis of limbs, lasting perhaps for some days, and then rather suddenly disappearing.

DIAGNOSIS.—The questions to be determined are, whether, looking to the symptoms presented by the patient, there is likely to be any organic lesion or change in the spinal cord or its membranes; or whether we have to do with mere functional perturbations induced by the shock or blow to which the patient has been subjected. In the absence of definite paralysis, or even with its presence for the first few days, the answer to this preliminary question will often be shrouded in doubt. To come to a definite opinion as to the precise nature of the change which a spinal cord, deemed to be damaged in some way after a concussion, has undergone, lapse of time and several examinations of the patient are often required.

In many cases in which compensation for an injury is claimed, a further complication appears. Here it is that the difficulty arises as to how much the symptoms experienced, or said to be experienced, may be due to an excited imagination, and how much to causes independent of the imagination, whether voluntarily or involuntarily aroused. It must be conceded that symptoms of injury are undoubtedly feigned by unscrupulous persons; and it seems also equally clear that, even unknowingly to the patient, the excitement consequent upon the accident, the details heard concerning the injuries of others, combined with the inquiries of doctors and of sympathising friends, tend to keep up and to exaggerate symptoms in many nervous patients, over and above those which may have resulted from the shock. Such patients also may make a more speedy recovery subsequent to trial and compensation than they had been making before the trial, and yet they *may* not have been in any sense impostors. It is true that such persons, however, do not recover quite so quickly as those others who for their own unscrupulous ends have been previously exciting their imaginations in a voluntary manner.

Prognosis.—In only the severest cases of concussion or shock is there actual danger to life (*see* Shock). Where, however, great prostration is induced, and especially in those who may previously have been suffering from heart-affections, or from a very excitable nervous system, life may be speedily brought to a close; or at most such patients may not survive a severe concussion more than a day or two.

Severe concussions of the cord may also form the starting-points of many and varied deviations from health, which may not begin to show themselves for weeks, or perhaps even months, after the initial shock. Among such sequelæ, which have come under the writer's notice, may be mentioned the following: Loss of flesh with general failure of nutrition, epileptiform fits, progressive muscular atrophy, lateral sclerosis of the spinal cord, a slowly increasing paraplegia (of uncertain pathological basis), and caries of vertebræ followed by angular curvature and paraplegia.

In other and slighter cases, time and rest, with suitable medical treatment, may be expected to lead to perfect recovery, sometimes speedily, but sometimes only after protracted periods of impaired health.

Treatment.—In the first instance, symptoms of shock have to be combated by the employment of warmth and stimulants. In subsequent stages, rest in the recumbent position must be enjoined for a time. It is of the first importance to make sure that the patient does take complete rest, and is kept free from excitement during the first few days after any concussion-accident, and that he gets sound sleep at night, under the influence of bromide of potassium, or of this together with chloral hydrate. If the condition of restlessness, with disturbed sleep, can be checked, then a mitigation of other symptoms may be expected to follow. The application of ice to the spinal column may at times be desirable; or pain must be relieved by the subcutaneous injection of small doses of morphine. Later on, tonics, with a simple nutritious diet and plenty of fresh air, together with rest, will be needed for the complete restoration of the patient.

H. Charlton Bastian.

2. Spinal Cord, Punctured or Gunshot Wounds of.—Synon.: Acute Traumatic Lesions of the Spinal Cord; Fr. *Plaies et Contusions de la Moelle Épinière*; Ger. *Rückenmarkszerreissungen.*

Ætiology and Anatomical Characters.—Punctured or gunshot wounds of the spinal cord are commonly made with knife, dagger, sword, or bullet.

In each set of cases, the wound in the spinal cord will be associated with perforation or rupture of some of the membranes, and also with hæmorrhage, either between them or into the substance of the cord. The arches of the vertebræ or their articular processes and some of the ligaments connecting them may be more or less damaged, and a wound commonly exists through the contiguous skin and muscles. In the cord itself, there may be either a clean-cut wound through certain of its columns and parts, or a broader crushing lesion. In each case more or less blood may be effused upon and below the cut surfaces of the cord. At later stages, there may be signs of inflammation of the membranes, as well as of local inflammatory softening of the substance of the cord.

Symptoms.—The signs and symptoms consequent upon wounds of this kind are subject to endless variations, in accordance with the different regions of the cord involved, the actual extent of the wound in its substance, and the possible presence of varying amounts of effused blood. These wounds often involve only a portion of the transverse area of the cord. It is indeed in this class of cases more especially that *hemiplegia spinalis* and *hemiparaplegia* are met with. Thus, where a unilateral lesion exists in the mid or upper cervical region, both arm and leg are paralysed, so that the state known as *hemiplegia spinalis* is produced; but where it occurs in the dorsal region, the one leg only is paralysed, and we have what is known as *hemiparaplegia.*

Since the experiments made many years ago by Brown-Séquard on the result of hemisection of the cord in certain animals, it has been supposed that the essential peculiarity in the latter cases is that on the side of lesion there is complete motor paralysis in the limbs or limb below; whils on the opposite side, the limbs or limb, and the trunk up to the middle line, are more or less completely anæsthetic—sensitiveness to impressions of touch, pain, temperature, and tickling being alike abolished.

Other minor peculiarities that have been described are these: On the side of *motor paralysis*, there is also vaso-motor paralysis, which carries with it, as consequences, (*a*) an elevation of temperature (from 1½° to 2° F.), and (*b*) a hyperæsthesia for all modes of sensibility (owing in part to hyperæmia in the limb and cord). Surrounding the body, at the level of the upper margin of anæsthesia on the side of sensory defect, there is usually a narrow girdle of hyperæsthesia; whilst below this level, on the side of the lesion, there is a half band of hemianæsthesia—whose depth varies with the longitudinal extent of the lesion. (The complete zone of hyperæsthesia has been thought to be due to hyperæmia of nerve-roots, and of the grey matter of the cord immediately above the lesion; while the half-zone of anæsthesia was supposed to be dependent upon destruction of the nerve-roots, and of the spinal cord for a certain extent at the seat of lesion.)

If bed-sores occur, they are said to be met with on the side of sensory paralysis; whilst in one or two cases signs of a joint-affection (in the knee principally) have occurred on the side of motor paralysis. There seems no reason for expecting any special muscular atrophy or diminution of faradic irritability on the side of motor paralysis, except in parts of those muscles whose nerve-supply comes from the portion of the anterior cornua actually destroyed by the lesion. In many cases, especially at first, there is paralysis of the bladder and of the rectum, or there may be incontinence of urine. Later on, these troubles tend to diminish. The superficial and deep reflexes are generally found to be exaggerated on the side of lesion.

In gunshot wounds, whether occasioned by pistol or rifle, splinters of bone may be depressed at times, so as to compress and irritate the cord, and thus the symptoms may be made to approximate more closely to wounds of the next category.

After a few days the symptoms may be complicated by those of spinal meningitis, or extended by the spread of an inflammatory softening of the cord above and below the seat of lesion.

Diagnosis.—The primary cause of the patient's condition is generally only too obvious. It may be clear that we have to do either with a punctured or with a gunshot wound in some region of the spine; but subsequently many, and often very difficult, questions require to be solved. It is of first importance to learn whether the cord itself is really damaged, or whether the symptoms are in the main caused by epi-dural or subarachnoid hæmorrhages (*see* Meninges, Spinal, Hæmorrhage into). In the former case there will be evidence of complete or partial interruption of conduction in the cord, to or from all parts below the seat of lesion, and not of a mere local implication of nerve-roots. If it seem probable that the cord itself is damaged, we have to determine whether it is completely cut across, or only partially damaged—and if the latter, to what extent. These questions must be decided in the main by reference to the signs given in Spinal Cord, Diseases of, § 7.

Should the case be seen for the first time several days after the injury, an exact diagnosis as to the amount of damage to the cord itself is often greatly obscured by the existence then of certain secondary pathological conditions—more especially localised inflammation of the meninges, or secondary inflammatory softening, extending perhaps above or below, or in both directions, from the original wound. A process of softening may also extend transversely through the whole substance of the cord, even where only a unilateral lesion had previously existed.

Prognosis.—This, as a rule, is bad in all cases of traumatic injury of the spinal cord; and the gravity of the case is usually the greater the higher the wound happens to be situated in the cervical region. Wounds of the dorsal or lumbar region of the cord are rather less serious, so far as life is concerned.

The degree of recovery from paralysis of limbs will greatly depend upon the nature and extent of the wound. A clean-cut wound may be filled up by the growth of a kind of cicatricial tissue; but, so far as our knowledge goes at present, it must be said that there is no definite evidence that the nerve-substance of the cord can be reproduced in man. It is remarkable that this should be so, seeing that the power of repair in cut or damaged peripheral nerves has been so clearly established.

Treatment.—Absolute rest, with cold applications, and possibly local blood-letting, will be needed in the first instance.

Subsequently, when immediate danger from shock and from the spreading of local inflammation has passed away, the patient must be treated upon the general principles applicable to all cases of paraplegia—which principles will be found set forth in 9. Spinal Cord, Softening of.

H. C. B.

3. Spinal Cord, Sudden Crushing Lesions of.—Fr. *Compressions Brusques de la Moelle Épinière*; Ger. *Rückenmarksquetschungen.*

Ætiology and Anatomical Characters.—The above form a class of wounds sufficiently distinct to need separate treatment. This kind of damage to the cord may be produced by the sudden giving way of a carious vertebra in any part of the spinal column; more rarely by a heavy blow on the back, which does not fracture the spine; or, in a modified form, by the bursting into the spinal canal of an aortic aneurysm, after its erosion through the vertebræ. But in the majority of cases such wounds of the spinal cord are the results of forms of external violence which cause fracture and dislocation of vertebræ, in some portion of the spinal column between the upper cervical and the upper lumbar region. When this occurs, displacement of vertebræ, even to a slight extent, especially in the dorsal region, in which the spinal canal is narrowest, is sufficient to produce severe pressure upon, or crushing of, the spinal cord. The membranes may not be torn across, and the actual dislocation may at times be only momentary, but the substance of the cord itself may be greatly compressed or reduced to a blood-stained semi-fluid mass of pulp. After some hours there are obvious signs of a commencing inflammatory reaction in the membranes; and above and below the seat of lesion similar changes are apt to be set up in the spinal cord itself, which may go on to the production of a variable amount of inflammatory softening. The patient may die, however, before any of these latter changes have been established.

Symptoms.—These vary much, according to the region of the cord involved. Still, in spite of differences thus dependent upon the seat of injury, there is a certain general similarity in the symptoms produced by all crushing lesions of the spinal cord. They are usually of this nature: There may be more or less marked evidence of shock; complete paralysis, both motor and sensory, of parts below the seat of lesion; in addition to severe pains in the back, girdle pains surrounding the body at the upper limit of sensory and motor paralysis; increased heat or possibly undue coldness of the body throughout the paralysed parts; complete paralysis of bladder with retention of urine, gradually giving place to incontinence; paralysis of intestine, extremely obstinate at first, but subsequently complicated with involuntary evacuations after the administration of purgatives; and extinction of all reflex actions at first.

In the course of two or three days, if the patient should survive, other general symptoms become well-marked, owing to the establishment of a local meningitis, together with some amount of traumatic myelitis. Amongst these we have general fever, with an increase of the 'girdle sensation,' and of pains in the limbs; twitchings in the limbs or in particular muscles; and also a general increase in reflex actions, where the crush has been only partial, though where the whole thickness of the cord has been destroyed the deep and most of the superficial reflexes in the paralysed parts continue to be abolished.

The above-mentioned complicating pathological processes may gradually subside, but there will still be danger to life from the supervention of severe cystitis or of extensive bed-sores, together with one or other of the various sequelæ to which such conditions are apt to give rise.

The additional symptoms and variations met with, according as the crushing lesion occurs in different regions of the cord, are as follows. They increase in number the higher the lesion occurs in the spinal cord. *See* Spinal Cord, Diseases of: § 8.

When it is situated in the *lumbar swelling* we have, in addition to the limitation of the paralysis to the lower extremities, and a more or less complete extinction of related reflex actions, the appearance of rapid atrophy in some of the paralysed muscles, together with the manifestation of the electrical reaction of degeneration. The bladder and rectum are apt to be completely paralysed.

With the lesion in some part of the *dorsal region* we have sensory and motor paralysis of the trunk up to a certain level, with an absence of the rapid atrophy and before-mentioned electrical reaction in the muscles of the lower extremities, though some atrophy and the presence of this reaction may occur in some of the trunk-muscles innervated from the damaged region of the cord. In addition (and notably where the lesion is in higher parts of the dorsal region) there may be some weakness of voice, some interference with the movements of respiration (especially with those of expiration), as well as marked and continuous priapism. The superficial and deep reflexes may be depressed or exalted, according to the complete or partial nature of the damage at the seat of lesion.

With the lesion in the *lower cervical region* the upper extremities are partly paralysed, both as regards sensation and motion; the movements of respiration are much more gravely interfered with (expiration especially), whilst inspiration is of a purely abdominal type; the voice is notably weak and feeble. Continued erection of the penis is more frequently met with; and in some cases a remarkable hyperpyrexia supervenes, in which the temperature before death may rise to 108°–110° F. Should death not occur in this way, it is very apt to supervene in the course of a few days, by gradual failure of respiration, which grows worse than it was in the early days of the affection, owing to the secondary myelitis which becomes established, implicating the cord and nerve-roots at a level higher than the original wound. The pulse is often much interfered with, but variously: it may be less frequent or much more frequent than natural; it may be small, irregular, and frequent; or full, regular, and infrequent in its beats. There may also be signs of paralysis of the vaso-motor nerves supplying the neck and head, perhaps to a more marked extent on one side than on the other.

Where the lesion occurs in the *upper cervical region* of the cord, complete paralysis of the trunk and of all four extremities may be recognised, if death does not occur too suddenly to allow even this to be observed. The sudden death, so apt to occur in these cases, is due to shock, and to the fact that the diaphragm may be paralysed as well as the other respiratory muscles. Where the lesion does not involve the whole of the roots of the phrenic nerve, and where the shock has not been too abrupt and violent, life (with extremely difficult respiration and almost complete loss of voice) may be prolonged for a few hours.

An admirable series of cases illustrating these crushing injuries to the spinal cord is to be found in Ollivier's work (3^{me} éd., t. i., p. 253 *et seq.*); whilst the best modern book dealing with the subject is Thorburn's work, *A Contribution to the Surgery of the Spinal Cord*, 1889.

Diagnosis.—If the existence of fracture and dislocation of vertebræ can be substantiated, the probabilities are always in favour of the presence of a crushing lesion in the spinal cord. Otherwise, after a very severe fall or blow upon the back, doubts may be at first entertained as to whether we have to do with the effects of concussion alone, or with this *plus* some amount of crushing of the cord or of hæmorrhage upon or beneath its membranes. The subsequent course of the symptoms may, however, in a day or two, enable us to resolve these doubts.

Prognosis.—The prognosis in lesions of this kind, as already indicated, is much graver than in the case of mere punctured wounds of the cord—these being oftener slight and partial in their transverse extent. Death may occur immediately; or at any time during the first week—in the main from failure of respiration and of the heart's action. It is only in exceptional cases, and where the lesion is in the dorsal or lumbar region, that life is prolonged for several weeks or months. Such lesions are probably too severe to admit of anything like thorough repair. Paralysis, therefore, of a more or less complete kind, is lasting, and the prognosis will always be distinctly bad wherever the superficial and deep reflexes remain absent after the symptoms of shock have subsided (*see* Spinal Cord, Diseases of: § 4, (*a*)). But even where life is prolonged for six to twelve months or more, it is, as a rule, ultimately lost, owing to the establishment of sloughing bed-sores and ulcerative cystitis, followed perhaps by blood-poisoning, extensive meningitis, or other complications.

Treatment.—In many of these cases treatment is useless and death inevitable. In those which are of a less urgent nature, the possibility of bringing about some relief by trepanning, with the view of elevating any depressed fragments of the vertebral arches, should not be lost sight of; and, as Mr. Bowlby has pointed out, this should be borne in mind especially in those cases in which the reflexes in the paralysed parts are not abolished. Except, indeed, for the fact that parts surrounding the cord are damaged, so that rest in one position is often indicated, the treatment of these cases after the first urgent symptoms have abated does not differ from that which is appropriate (*see* 9. Softening of) in other well-marked cases of paraplegia, where there is a tendency to the formation of sloughing bed-sores, and to the establishment of cystitis.

H. Charlton Bastian.

4. Spinal Cord, Slow Compression of.—Synon.: Chronic Traumatic Lesion of the Spinal Cord; Fr. *Compression Lente de la Moelle Épinière*; (in part) *Paraplégie Douloureuse des cancéreux*; Ger. *Langsame Compression des Rückenmarks.*

Ætiology and Anatomical Characters.—The most frequent causes of the set of symptoms grouped under this head are to be found in diseases of the vertebræ, and especially simple inflammatory or scrofulous caries of the bodies of the vertebræ, leading to *angular curvature*, or 'Pott's disease.' Still, other kinds of disease of the vertebræ may also be productive of slow compression of the spinal cord, and of that form of localised softening of the organ which is so commonly met with in this class of cases, the so-called 'compression myelitis.' Among these may be mentioned *cancer* of the vertebræ, either primary or secondary; also *exostoses* projecting into the spinal canal, or more irregular thickening of the bones in this situation. In cases of vertebral caries, in addition to the not infrequent presence and pressure of abscesses, a tough, yellow, scrofulous growth often infiltrates the posterior vertebral ligament, and thence spreads to the dura mater, here producing thickening and irregular fungosities which may press injuriously upon the spinal cord—more especially upon its antero-lateral columns. In these cases, though no tubercular disease is found within the dura mater, the spinal cord, as a result of degenerative changes, may, in the worst cases, be distinctly softened opposite, and perhaps for a very short distance above and below, the site of compression. At first such softening is principally apparent in the columns above mentioned; but in cases of longer duration it may involve nearly the whole thickness of the cord, and be followed by the usual ascending and descending 'secondary degenerations' (§ 5, (13)). The softened matter itself is generally reduced to an almost bloodless fluid or semi-fluid pulp, either of a whitish or dull yellowish-white colour, and there is generally no undue vascularity of the immediately adjacent portions of the cord.

In certain cases of very slowly induced

compression no such softening of the cord is produced; there is rather a gradual atrophy or disappearance of the nerve-substance as the pressure increases, together with a sclerosis of what remains. This may occur, for instance, where the cord is pressed upon by some exostosis, or by irregular growth and thickening of the inner surface of the spinal canal, such as occurs occasionally in one or other of the cervical vertebræ.

It has long been known that no constant relation exists between the amount of angular curvature and of paralysis in different cases of vertebral caries. Paralysis may be absent where curvature is most marked. On the other hand, with no curvature and with only a slightly marked projection of one or two vertebral spines, paralysis may yet exist to a well-marked degree. This is due to the fact, that in such cases the cord is only very rarely compressed by the bones, whilst it is frequently more or less pressed upon by abscesses or by the yellowish growths which protrude from the inflamed or carious vertebræ, or which produce thickening and infiltration of the dura mater at the seat of disease; and changes of this sort may be well-marked even where angular curvature is scarcely appreciable.

Again, where angular curvature is present, the posterior surface of the bodies of the vertebræ, corresponding with the angle, is often bent, rough, and eroded, and the cord over it is apt to become softened, though there may be no compressing growths or thickenings of the membranes.

Thus it happens that the paralysis in these cases may be variously produced. And seeing that it is often due to pressure by inflammatory products rather than to pressure or irritation from the diseased bones themselves, we may the better understand the fact that occasionally a great improvement may set in and become established in regard to the paralysis, although the angular curvature of the spine remains as obvious as it ever has been.

In addition to slow compression of the cord resulting from diseases of the bones of the spine, a somewhat similar condition may be induced by the various kinds of tumours of the meninges, or by hydatid growths implicating these parts (*see* MENINGES, SPINAL, Diseases of: New-Growths and Adventitious Products of). Confined within the narrow limits of the spinal canal, such tumours, even though of small size, may soon come to exercise a very injurious amount of pressure upon the spinal cord.

SYMPTOMS, COURSE, AND TERMINATIONS.—We shall point out some of the distinguishing characteristics of the paralysis which is often associated with vertebral caries, and afterwards refer to the peculiarities met with where meningeal tumours exist.

In *vertebral caries* with commencing pressure upon the spinal cord, the symptoms will be different, according to the part of the column implicated. The affection is frequently ushered in by an abiding pain in the spine and parts adjacent, often supposed to be 'rheumatic' in nature. Such pains commonly disappear when the patient is in the recumbent position, except during the acts of sneezing or coughing. They are commonly induced by particular kinds of movements, which are more or less difficult on this account. There is also some weakness in the lower part of the body and in the lower extremities. The mere 'weakness' may continue for weeks or even months before there is anything like actual paralysis; though at last this may show itself somewhat abruptly. The patient now becomes unable to stand, though still able to move the legs slightly whilst lying in bed. At this stage sensation is little, if at all, interfered with; but there may already be some increase in the readiness with which the knee-jerk manifests itself, and ankle-clonus may also be easily attainable. Next there may be startings of the limbs, and commencing rigidity of the muscles when passive movements are attempted; followed after a time by a more marked rigidity, which, when present in the calf muscles, will often prevent the manifestation of ankle-clonus and of the knee-jerk. Later, if pressure increases either upon the spinal cord or upon its posterior nerve-roots, sensibility in its various modes becomes implicated. At this period the exaltation of the reflexes often diminishes. For a time the degree of impairment of sensibility and the freedom with which the knee-jerk and ankle-clonus may be obtained fluctuates. Meanwhile, painful spasmodic contractions of the legs (with flexion of hip and knee joints) become habitual, persisting through day and night with only rare intermissions.

Although there is some general wasting of the muscles, together with a flabby condition when they are relaxed, they still react almost normally to the faradic current. The skin is often dry and scurfy. The temperature of the limbs is generally slightly lower than normal.

At the first onset there may be for a few days a difficulty in voiding the urine, but this power soon returns, and it often continues long after the limbs have become powerless. The bowels are perhaps somewhat constipated, but there is no incontinence of fæces, unless diarrhœa supervenes from any cause, or except when the reflex activity of the bowel is greatly exalted under the influence of aperient medicines.

The above condition of things may last long without much variation. But after a time there will be a gradual mitigation of the symptoms, or the reverse. In the latter case loss of voluntary control over the bladder and rectum appears; and (especially when the sensibility of the body and limbs becomes impaired) the tendency to the formation of sloughs and gangrenous bed-sores becomes increased. With these conditions other complications, such as cystitis, blood-poisoning, &c., may appear and greatly aggravate the condition of the patient, helping to bring about a more speedy termination.

In the case of *tumours arising from the meninges*, the onset of the affection may also be very gradual at first, though, perhaps, rather suddenly intensified at last. Here, however, the pressure very often comes upon the cord from behind, or it may at the same time implicate one or both lateral regions of the cord. At first, therefore, we commonly get variously impaired sensibility and neuralgic pains, or pains mixed with startings and cramp-like contractions in certain muscles, occurring in those particular regions of the body or limbs which are in relation with the nerve-roots slightly pressed upon and irritated by the new-growth. Great differences exist in different cases in regard to the degree and persistence of the initial pains. Subsequently these same nerves and the cord itself may become more severely pressed upon, and then loss of sensibility over the field of distribution of the nerve-roots is met with, together with loss or impairment of sensibility in all or some parts of the body the nerve-supply of which is from the cord below the compressed region. With this a minor amount of motor paralysis also occurs, which, however, subsequently becomes more marked, and ultimately complete. When this takes place we have all the signs and symptoms met with in a case of total transverse softening of the spinal cord at the level implicated (*see* SPINAL CORD, Softening of). This change is, in fact, commonly established by the persistence and increase of pressure due to the new-growth.

These are the broad outlines of the symptoms met with in such cases, which, of course, are subject to innumerable variations in individual cases, in accordance with differences in the region of the cord affected, together with the rate of growth, mode of incidence of pressure, and size of the tumour.

In *cancer of the vertebræ*, also, we have much the same grouping of symptoms; the preliminary pains being here especially severe (*see* Charcot's *Leçons*, 3^{me} éd., t. ii., p. 86).

DIAGNOSIS.—In the paralysis associated with *vertebral caries* the diagnosis depends upon the recognition of this causal condition, which, in the early stages, is often a matter of some difficulty. Much will depend upon the existence of pain in particular regions of the spine, or radiating therefrom; of pain which is relieved by the recumbent position, and greatly aggravated by coughing, sneezing, or stooping movements of different kinds (*see* H. Marsh in *Brit. Med. Journ.*, vol. i., 1881, p. 913). And yet in the absence of signs of caries, or of a scrofulous habit of body or history, or of an exciting cause for caries, in cases where there may be little or no prominence of vertebral spines, and even no pain from firm pressure or the application of a hot sponge, we may be helped in our diagnosis of the existence of caries by the distinctive characters of the paralysis itself, namely, its implication of motility principally, the exaggeration of the tendon-reflexes, the more or less marked rigidity of the legs, and the continuance of control over the bladder and rectum.

In cases of the latter type, or where there is only a slight prominence of two to four vertebral spines, it may be difficult, however, to establish a diagnosis between caries and *cancer* of the bodies of the vertebræ. It is true that a rounded prominence of several vertebral spines is met with in cancer more frequently than the angular projection commonly associated with caries; yet this single character will not always aid us: we must look also to the presence or absence of severe pains, to the clinical grouping of symptoms generally, and to the history of the patient.

The diagnosis of the other causes of slow compression of the cord to which reference has been made (exostoses or meningeal tumours) is usually a matter of extreme difficulty. We must be guided by probabilities based upon other associated states or conditions that may be recognisable in our patient, and also by the mode of onset of the affection.

PROGNOSIS.—We can only speak in general terms concerning the prognosis of the rather miscellaneous conditions which form the subject of this article. Cancer of the vertebræ or of the dura mater, compressing the cord, is the most serious of them all. The progress of such cases is usually both rapid and very painful, so that the end comes inevitably before many months have elapsed.

In vertebral caries associated with compression of the cord, the prognosis is extremely uncertain, especially where the disease occurs in the cervical region. It is also generally more grave where the pressure upon the cord is due to an abscess rather than to mere thickening of the dura mater. Under suitable treatment many of these cases practically recover more or less fully; in others complete transverse softening of the cord is produced. In the former class of cases the process of caries is arrested, the spoiled vertebræ are strengthened and bridged over by growth of new bony tissue (though, of course, the angular curvature of the spine remains), whilst recovery from the paralysis may be more or less complete. This latter kind of recovery takes place occasionally even after paralysis, with almost persistent contractions of the lower extremities, has existed for from twelve to eighteen months or even longer.

In cases of exostosis, hydatids, or meningeal tumours compressing the spinal cord, the prognosis will depend upon the part of the cord involved, upon the rate of increase of the symptoms of compression, and upon the extent to which a secondary myelitis or softening is established. The disease in these cases, in spite of stationary periods, or even those of slight improvement, is more or less continuously progressive, though it may last for many months, or, occasionally, even for a year or two. Some of the complications or accidents incident to the paraplegic condition ultimately bring the patient's life to a close.

Treatment.—Rest in the recumbent or in the prone position is, of course, absolutely essential in cases of vertebral caries or of cancer of the vertebræ. In addition to this, in many cases of vertebral caries, a poroplastic or plaster jacket may be needed, in order more effectually to secure absolute immobility of the affected portion of the spinal column. This, however, would have to be reserved for the more chronic cases or stages—for those in which active local treatment was no longer considered to be necessary or desirable, though a prolonged rest in bed may still be needed. Under such conditions the application of the jacket is a means of obtaining more complete rest for the damaged spine. Some surgeons, however, prefer to have recourse to a method of 'elastic extension' for procuring this fixation of the spinal column.

In cases of paraplegia associated with vertebral caries, the patient's general health requires the utmost attention during the period in which we are endeavouring to check the disease by the influence of rest. Good nutritious food and cod-liver oil will be required, combined with steel wine or the syrup of phosphate of iron. In some cases 10 to 20 grain doses of iodide of potassium (together with iodide of iron or small doses of perchloride of mercury) seem to do good. Where the patient suffers much from painful contractions of the legs (which may greatly disturb sleep), these may be very distinctly lessened by suspending weights to the feet (each being from two to four lbs.) from leather anklets, by a cord which passes over a pulley. Such weights may be used for weeks or months together, where necessary.

In regard to local measures, counter-irritation of some kind is generally had recourse to, either in the form of flying blisters near to and on each side of the portion of the spinal column which is affected, or else by the renewed application of moxas or the actual cautery to these regions. The latter more severe measures are still recommended by some authorities, though the experience of others, amongst whom was the late Sir Benjamin Brodie, is against their employment, as being of little or no use, and therefore adding needlessly to the sufferings of the patient. The writer is inclined to think that all the good which moxas or the actual cautery are intended to bring about may generally be as effectually achieved by the application of iodine liniment over the affected region of the spine about every fourth day.

There can be no doubt that treatment of this kind is often successful, though frequently after prolonged periods. The question, therefore, naturally presents itself, whether the duration of the illness, and in some cases the saving of life, may not be brought about by an early resort to surgical operation, with a view to opening abscesses and removing scrofulous growths that may be pressing upon the spinal cord. If some signs of recovery do not commence in three or four months it will probably be advisable to have resort to operation. Each case, however, will require anxious consideration in regard to this point.

Again, it must be borne in mind that some cases of compression of the spinal cord by meningeal growth may be also greatly relieved for a time, or even cured, by operative measures.

In the case where a hydatid tumour presses upon the spinal cord, and is also situated in part outside the vertebral spines, tapping might bring much relief. In the majority of the other conditions comprised within the limits of this article, little can be done to cure the state of things which is the cause of the spinal disease, so that it would only remain for us to treat the paraplegia and its attendant conditions upon the general principles applicable to them. These are fully considered under 9. Softening of.

H. Charlton Bastian.

5. Spinal Cord, Anæmia of.—Anæmia is not to be considered as the basis of any ordinary or common disease of the cord: in other words, there is no definite group of symptoms the existence of which is likely to be recognised more than once in a lifetime in any actual patient, which would justify the diagnosis 'anæmia of the cord.'

First, the writer would repudiate the notion that *anæmia* or *chlorosis*, as a mere blood-disease, is capable of producing, on the side of the spinal cord, any set of symptoms which can be marked off from those characterising the condition as a whole. In these diseases the functions of all the organs are impaired by reason of the impoverishment of the blood. The brain and spinal cord, on account of the delicacy of their functions, will, of course, suffer to a notable degree; and when general debility is extreme, a paresis of the lower extremities may be notable beyond that of other parts of the body, because the legs in standing or in walking have to support so great a weight. Where anything more than such paresis exists—that is, where there is actual paraplegia, such symptoms are not to be explained by a mere anæmia of the cord. Other causes are to be looked for. Jaccoud's whole group of *paraplégies dyscrasiques* will probably disappear before a more thorough knowledge of the actual mode of causation of these and many other obscure forms of paraplegia.

Secondly, *embolism* and *thrombosis* of spinal arteries will produce temporarily, and in quite limited regions of the cord, a condition of anæmia. Such local anæmia would probably soon be rectified by the establishment of a collateral circulation; and in the event of this not taking place, local 'softening' of the organ would ensue. A paralysis owning such an origin would not, therefore, be spoken of as resulting from 'anæmia of the cord.'

Thirdly, *pressure* upon parts of the cord will occasion anæmia and ultimately softening, but the symptoms in a case of this sort will depend mainly upon the pressure itself interfering with the functions of the nerve-tissue thus affected.

Beyond the conditions above referred to, there is the possibility that definite groups of paralytic symptoms may be occasioned by anæmia induced by mere functional *spasm of the arteries* in certain regions of the cord—spasm, that is, which persists day after day. This has been supposed by Brown-Séquard to be the condition existing in the cases of so-called 'reflex paraplegia' (*see* No. 28), and also in some forms of functional paralysis of spinal type (*see* No. 30). If such a condition of persisting arterial spasm be possible, and an actual cause of paralytic symptoms, we may well ask whether it too ought not after a time to lead to actual softening, or at least to some degree of degenerative change in the spinal cord. It seems possible, however, that where the amount of blood sent to a part of the cord is but small, the degradation of function may be more marked than the degradation of structure.

There will still remain a very few exceptional cases, in which a condition of real anæmia of the spinal cord is brought about in man, just as it has been brought about in some of the lower animals whose abdominal aorta has been tied or compressed. When the blood-supply is thus suddenly cut off from the lumbar region of the cord in animals, their hinder limbs become paralysed almost immediately, and continue paralysed as long as the blood-supply of the cord happens to be arrested. But if, after a mere brief interval, the blood is again allowed to take its natural course, the temporary paralysis disappears completely in a very short time. A condition of this kind seems to have occurred in a patient, formerly under the care of the late Sir William Gull, who suddenly became paraplegic, apparently owing to an abrupt arrest of the blood-current through the abdominal aorta, as was indicated by the cessation of the femoral and other pulses in the lower extremities (see *Guy's Hospital Reports*, 1857, p. 311). The man continued paraplegic for months, and only recovered when the collateral circulation became, after a time, pretty fully established. In a very few other cases referred to by Erb, in which paraplegic symptoms were associated with an obstruction of some kind in the abdominal aorta, he thinks that these symptoms, supervening as they did rather less suddenly, may have been in great part due to the deficient blood-supply to the muscles and nerves of the lower extremities, rather than to anæmia of the cord—to a peripheral, that is, rather than to a centric anæmia.

H. C. B.

6. Spinal Cord, Hyperæmia of.—This condition again is more frequently talked of than it deserves—looking to the small amount of positive knowledge we possess upon the subject.

Hyperæmia of the cord must be either passive or active, that is, it must be a result of *mechanical congestion* or of *arterial determination.*

Mechanical congestion.—In obstructive heart-disease extreme congestion of the spinal cord may exist for months without producing any distinct symptoms of disease of the spinal cord. A constantly congested spinal cord would doubtless perform its functions in a less vigorous manner than natural, but such effects would be slowly evolved and comparatively obscure. After a long time the effects might become more marked, owing to the overgrowth of connective tissue within the organ. We may indeed have the starting-point of a general sclerosis of the spinal cord under such conditions; but this secondary change, when only slightly marked, may, even in the spinal cord, produce no very definite symptoms.

General mechanical congestion of the cord is probably more frequent and more easily brought about than a congestion involving parts of the organ. Still from various causes there may be undue pressure upon certain veins, which directly or indirectly convey blood away from special regions of the cord and its membranes. Such an event cannot, however, be regarded as a likely cause of a congestion productive of morbid spinal symptoms, if we consider the absence of distinct symptoms resulting from extreme general congestion of the cord; and also the fact of the very free anastomosis of all the spinal veins.

Active hyperæmia may in its origin be of two kinds—'reflex' or 'inflammatory.'

'Reflex' hyperæmia of the cord and its membranes is possibly a phenomenon of great frequency, manifesting itself locally in certain regions—the seat of the process varying according to the conditions under which it arises. It might be immediately caused by vaso-motor paralysis, implicating certain vessels of the cord and their branches; and would thus involve an increased afflux of blood to the tissues contained in the corresponding vascular territories. We know that such an increased afflux of blood may exist in other tissues for some time without inducing tissue-changes of an appreciable kind (Brown-Séquard). It is fair to suppose, moreover, that any symptoms induced by such increased afflux of blood to certain regions of the cord would be indicative of exalted rather than of depressed function; for example, hyperæsthesia, actual pains and spasms, or increased reflex excitability, rather than their opposites.

In weak and irritable states of the nervous system it is quite possible (though nothing more definite can be said) that such vaso-motor paralysis, and also vaso-motor spasms inducing localised anæmias, may manifest themselves in spinal vessels, as they do in cutaneous vessels, by familiar flushes or pallors. If occurring in the skin, however, these would mostly be temporary phenomena, and not capable of producing the symptoms of an abiding disease. How frequent such reflex local hyperæmias (whether brief or prolonged) may be in the spinal cord, and in what precise manner they are excited, we do not know. Suppression of the menses or of hæmorrhoidal fluxes, the presence of worms in the intestine, the prolonged incidence of cold and wet, or severe concussions of the spine, any or all *may* operate in this particular manner—but for proof that, as matter of fact, they do, we may look for evidence in vain.

The subject of 'inflammatory hyperæmia' will be briefly considered under the next heading. In this case, in addition to changes in the vascular system, the effects of the inflammatory process as a whole have to be taken into account. Even in the first stage of inflammation something prior to and beyond the mere 'active' congestion has to be thought of.

From what is said above, it may be seen how shadowy is our present knowledge concerning the existence of any definite sets of symptoms which can be ascribed to non-inflammatory hyperæmia of the cord, either general or local.

H. CHARLTON BASTIAN.

7. Spinal Cord, Inflammation of.

SYNON.: Myelitis; *Myelitis Acuta*; Softening of the Spinal Cord (in part); Fr. *Myélite*; *Myélite aiguë*; *Inflammation de la Moelle Épinière*; *Ramollissement de la Moelle Épinière* (in part); Ger. *Myelitis*; *Rückenmarksentzündung*; *Erweichung des Rückenmarks* (in part).

NATURE, ÆTIOLOGY, AND PATHOLOGY.—To speak definitely on this subject, in the present state of knowledge, is extremely difficult. This is due to several causes. In the first place, it is owing to the fact that so much uncertainty exists in the minds of many eminent pathologists and physicians as to what ought rightfully to be included under this term; and, secondly, because by a very large number of writers the term is understood and used in the vaguest manner, but with a manifest tendency to comprise under it the largest possible number of affections of the spinal cord. Critical discrimination seems to have been, and still to be, in abeyance with many who describe or report cases of disease of the spinal cord. They set down as instances of 'myelitis' not only all cases in which the substance of the spinal cord is softened, but still more all those in which it is indurated—and, no less impartially, those in which it is merely degenerated.

(1) The notion that common 'softenings' of the spinal cord are of inflammatory origin has persisted with little alteration, although for nearly thirty years pathologists have been interpreting altogether differently the mode of production of apparently similar 'softenings' of the cerebrum and cerebellum. Can it be that 'softening' as it occurs in the majority of cases in these latter organs is of non-inflammatory origin; while in the majority of apparently similar cases occurring in the spinal cord, the process is really inflammatory in its nature? It is true that in association with the majority of cases of primary softening in the brain thrombosis or embolism of its arteries may be detected, and that (owing to the peculiarities of its vascular supply) no such occlusions of vessels can often be detected in association with softening of the spinal cord. *See* SPINAL CORD, Diseases of: § 5, (8) and (9).

(2) Then, again, perhaps it may be said that without adequate cause the very localised changes occurring in and around the great ganglion-cells of the anterior cornua, in 'acute' and 'chronic spinal paralysis,' have been set down as inflammatory in their nature, and new names have been given to these affections, tending to ratify this view as to their origin. Thus they are spoken of by some as cases of *anterior polio-myelitis*, or more briefly, and, so far, better, as cases of *cornual myelitis*. But localisation of an inflammatory process to great ganglion-cells and their immediate surroundings at present constitutes a rather unintelligible process to many pathologists. And mysterious as these particular changes are, from the point of view of their ætiology, on any hypothesis that has yet been started, it would perhaps be simpler, and more harmonious with the nature of the observed conditions themselves, to regard them as of a degenerative type. If

the slower and more isolated changes characteristic of 'progressive muscular atrophy' are to be placed in this category (and in regard to them there is absolutely no evidence either clinical or pathological that can be adduced in favour of an inflammatory origin), then also it becomes easy to believe that, under some at present imperfectly defined conditions, a change of the same kind may set in more rapidly in these the most specialised of all the anatomical elements met with in the spinal cord, so as to produce the more acute affections above referred to. The slight secondary overgrowth of neuroglia often occurring around the degenerated ganglion-cells does not in the least militate against this view as to the pathology of the process; a similar secondary change occurs also in the process next to be referred to, and will be found to be easily explicable without the necessity of having recourse to the ever-ready and fashionable hypothesis of inflammation.

(3) 'Secondary degenerations' of the spinal cord have indeed, in spite of their name, and of what is known as to their origin, been erroneously regarded by some writers as inflammatory changes (Ziemssen's *Cyclopædia*, vol. xiii. p. 769). When nerve-fibres are cut across, those portions which are severed from their connexion with certain ganglion-cells are no longer able to preserve their nutritive integrity. Simultaneously throughout their whole length fatty degeneration affects their white substance. Myeline breaks up, and becomes disintegrated as it does in non-inflammatory softenings in the brain; and very speedily granulation-corpuscles begin to form abundantly throughout the changing area. But though fatty degeneration thus occurs simultaneously in all the cut fibres of the band, the vascular supply of this tract of tissue has not been altered. Since the blood in the diseased area is not utilised by the nerve-tissues proper, except to a very small extent, a large excess of nutriment is placed at the disposal of the neuroglia, and this undergoes a well-marked hyperplasia. Thus a band of tissue-change is produced in which some of the characteristics of softening are blended with those pertaining to a patch of sclerosis. In brief, we have effects resulting from a primary fatty degeneration of the nerve-fibres, and a secondary hyperplasia of the neuroglia; and from first to last there is not the least reason for believing in the existence of an inflammatory process.

(4) If we turn now to 'sclerosis' of the cord of primary origin, we again meet with processes which are commonly regarded and described as forms of '*chronic myelitis*.' This nomenclature is objectionable as applied to the processes in the spinal cord, just as it is in its application to like processes occurring in other organs, as the liver, the lungs, or the kidneys. Fibroid overgrowth, which forms the basis of so many examples of 'cirrhosis' or 'sclerosis' in different organs and tissues of the body, is a process pathologically intermediate between inflammation on the one hand, and degeneration on the other. What were formerly named 'interstitial inflammations' are now the 'non-inflammatory hyperplasias' of some pathologists, and the 'fibroid degenerations' of others. It would seem that the view as to the inflammatory nature of such processes is erroneous, if we look either to what is known concerning their modes of initiation, or to the actual nature of the changes themselves (which agree in every particular with those of infiltrating new-growths); it would seem, moreover, not less erroneous if we look to the clinical history of the affections themselves in which these scleroses occur. It conveys, therefore, an altogether erroneous implication to speak of such mere fibroid overgrowths as so many instances of 'chronic myelitis.'

Thus, it will be seen that the writer attributes to inflammation a far more restricted *rôle* in the production of morbid conditions of the spinal cord than is customary. The various forms of so-called 'chronic myelitis' he would exclude from that category. He would do the same for the set of changes known as 'secondary degenerations'; and also for those which are characterised by more or less acute atrophic processes implicating the great ganglion-cells of the anterior cornua.

Of the processes above referred to in order, there remains, therefore, only the class of 'softenings' of the spinal cord. That many of these are of a simply degenerative type (due to vascular occlusions and disturbances of blood-supply), and that, in the great majority of cases, these are the instances in which 'softening' appears to occur as a *primary* process, is the view which seems to the writer most in accordance with existing knowledge. On the other hand, it seems clear that in many cases changes, truly inflammatory in their origin and progress, may terminate in the production of states of 'softening' of the cord, which are indistinguishable by the naked eye from the softenings of degenerative type, and which, except in their early stages, can as yet also be very imperfectly discriminated by the microscope.

These latter true *inflammatory softenings* very rarely occur as primary pathological states; they are met with rather as *secondary* changes.

Thus we may get inflammatory softenings (*a*) spreading around and from wounds or other traumatic lesions of the spinal cord; or (*b*) starting from some blood-clot or tumour situated in or pressing upon the substance of the cord. It is not by any means clear, however, that all the forms of softening which arise in the latter manner should be regarded as of an inflammatory nature; and much room for doubt also exists as to the real pathogenesis of many cases of so-called 'compression myelitis.' Again, inflammatory softenings, going on even to suppuration, may be set up in the spinal cord (*c*) by embolism or thrombosis of septic origin. Still another cause of true inflammatory changes in the spinal cord (*myelitis peripherica*) is to be found (*d*) in spinal leptomeningitis (*see* MENINGES, SPINAL, Diseases of: Leptomeningitis).

Suppuration is clearly a process of inflammatory origin, and might therefore be expected to occur occasionally in the midst of 'softenings' which result from inflammation. In the light of what has been said above, the following statement by Erb is of considerable interest. 'Actual suppuration occurs very rarely,' he says, 'in acute myelitis. When abscess of the cord does form, it is generally secondary to a severe traumatic lesion or to suppurative meningitis. In spontaneous myelitis, on the other hand, suppuration is exceedingly rare, and has only been observed in a very few cases.' Thus suppuration is met with just in those forms of softening which are undoubtedly of inflammatory origin; and, on the other hand, it is not met with in the ordinary cases of primary or spontaneous softening, here assumed to be of non-inflammatory nature.

One other condition requires to be referred to here, and that is the so-called *acute central myelitis*, described originally by Albers, and afterwards studied by Hayem (see *Archives de Physiologie*, 1874, p. 603). These are cases in which apparently spontaneous 'softening' is met with, implicating in the main the central grey matter, and that often through a considerable extent of the cord. At times, however, the softening extends beyond the grey matter, so as to involve more or less of the surrounding white substance, when it has been termed *myelitis diffusa.* Considerable obscurity still prevails in regard to the ætiology of these affections. In some cases, such a change has been met with as part of an infective process, in which minute vessels in the grey matter of the cord have been found obstructed with micrococci. Occasionally, moreover, in certain at present imperfectly known conditions, minute thromboses may, as Dr. J. Hamilton has shown, occur throughout the spinal cord, and more especially in its grey matter, and thus lead on in the main to the production of a central softening (see *British and Foreign Review*, April 1876, p. 447). In this latter case, the patient was suffering from pyelitis, and it is supposed that there may have been some blood-poisoning. Still it was not ascertained that the multitudes of minute thrombi were either associated with or caused by micrococci in the vessels. It appears probable, however, that if from any cause minute widespread obstructions of small vessels occur in the spinal cord, softening would take place principally in the grey matter, owing to its greater vascularity. We should thus get that particular distribution of this change which is met with principally in cases of so-called 'acute central' or 'diffuse myelitis.'

A careful study of the two cases of this disease recorded by Hayem has by no means sufficed to convince the writer that they ought to be regarded as having had an inflammatory origin. Neither the mode of onset nor the symptoms of the disease lend any distinct support to this view; nor do the results of the elaborate examination, to which the spinal cords were submitted by this accomplished observer, at all satisfy the writer that the pathological conditions met with were inflammatory either at their commencement or in their subsequent progress. *See* 9. Softening.

SYMPTOMS, COURSE, AND TERMINATIONS.—From what has been said, it will be seen that true inflammatory conditions of the cord are only with extreme rarity of *primary* origin, and that they occur, for the most part, as *secondary* complications in association (*a*) with wounds or injuries of the cord; (*b*) with foreign bodies in its substance; (*c*) with pyæmic processes; or (*d*) with spinal leptomeningitis, either simple or tubercular.

The supervention of a real myelitis in the course of either of these diseases of the spinal cord would perhaps be associated with an exaggeration of the already existing febrile condition; with an increase in the amount of paralysis, and in the degree of interference with sensibility; possibly also with more pain, restlessness, and spasms.

Myelitis may become associated with more or less of distinct suppuration, and almost certainly goes on to the formation of well-marked foci of softening. These may remain limited in site, but occasionally they have a distinct tendency to spread above and below the original seat of injury or disease. Such depots would probably undergo subsequent changes, very similar in kind to those which occur in foci of non-inflammatory softening.

DIAGNOSIS.—All that can be said under this head has been referred to above in connexion with the symptoms characterising the supervention of myelitis.

PROGNOSIS.—The gravity of any wound or lesion of the spinal cord, or attaching to the presence in it of blood-clot or tumour, is, of course, greatly increased by the supervention of inflammatory changes about their immediate confines. Again, the fact that an inflammation of the spinal meninges is complicated with similar changes in the substance of the spinal cord itself, cannot fail greatly to aggravate a case of simple spinal leptomeningitis. For, even should recovery from the acute affection take place, the actual degree of abiding paralysis, ataxy, or impairment of sensibility would much depend upon the degree in which the substance of the spinal cord had been itself implicated.

TREATMENT.—The amount of power that we possess in controlling an inflammatory condition of the spinal cord is probably not great. Little, if anything, is at present to be done with mere drugs. The patient should, if possible, lie in the prone position, or, failing this, on his side, with absolute rest. The advisability of abstracting blood locally by cupping or leeches should be entertained, and must depend much upon the amount of local pain or tenderness. In some cases it seems to be of service. Or we may trust rather to the application of cold externally, in the form of ice-bags, along the spine. At the same time the patient should be kept upon spoon diet, with a sparing amount of stimulants; and the bowels should be relieved by the aid of copious warm enemata, which may also act usefully as derivatives. The limitations circumscribing our efforts at direct therapeutics must be compensated as far as possible by attention to the state of the general health, and by the most careful and assiduous nursing, in the hope that the morbid process may after a time abate, and that, in the absence of collateral complications, the patient may make at least a partial recovery.

H. CHARLTON BASTIAN.

8. Spinal Cord, Hæmorrhage into.

SYNON.: *Hæmatomyelia*; *Hæmatorrhagia Medullæ Spinalis*; Spinal Apoplexy; Fr. *Hématomyélie*; *Apoplexie de la Moelle Epinière*; *Des hémorrhagies intrarachidiennes*; Ger. *Rückenmarksapoplexie*; *Spinalapoplexie.*

ÆTIOLOGY AND ANATOMICAL CHARACTERS. Hæmorrhage into the spinal cord is a comparatively rare event. It occurs under three different conditions, namely: (1) as a result of concussion or violence; (2) as a secondary event, consequent upon some definite pre-existing morbid condition; and (3) as a primary event, or local pathological accident.

We are here specially concerned with hæmorrhages into the spinal cord belonging to the third of these categories, and may in a few words dismiss the other two.

(1) Traumatic hæmorrhages, small in extent, may, as already stated, occur in almost any region or part of the cord as a result of some severe concussion (*see* 1. SPINAL CORD, Concussion of). Again, it may occur in the grey matter, and even in the white substance to a smaller extent, close to and as an appanage of wounds of the cord. In each of these cases symptoms due to the hæmorrhage itself would probably be obscured by the general set of symptoms resulting from the concussion or injury.

(2) Secondary hæmorrhages are, however, more closely connected, from the point of view of symptomatology, with those forming the special subject of this article. During the growth of certain soft tumours in the cord, a rupture of some of their vessels may take place, so as to cause hæmorrhage either into the growth itself, or else into contiguous regions of the cord. Such an event would be signalled clinically by the sudden exacerbation of the symptoms previously existing. But a combination of greater importance, though one of considerable obscurity, consists in the co-existence of a 'central myelitis' of the grey matter of the cord through more or less of its length, with a central hæmorrhage of nearly similar extent. The existence of any such 'central myelitis' as an independent disease of the cord seems to the writer very doubtful. It is at least equally probable that the hæmorrhage has been primary, and that the 'myelitis' is of secondary origin around the blood-clot. It need not be denied, of course, that in other cases hæmorrhage does occur occasionally into the midst of a focus of softened tissue in the spinal cord, just as it occurs occasionally under similar conditions in the midst of softened brain-tissue. Again, hæmorrhage may take place into or on the confines of a soft sarcoma or glioma in the substance of the spinal cord.

(3) Primary hæmorrhages differ as regards the amount, the site, and the distribution of the blood effused in different cases. In connexion with scorbutic states, and also independently of these, small hæmorrhages may occasionally occur into the substance of the cord, without producing any very distinct symptoms. But, at other times, a comparatively large quantity of blood may be effused into the cord, and then it occurs almost invariably into the central regions of the grey matter, through which it may extend for a variable distance, upwards or downwards, or both. When the quantity is smaller, the blood may be effused into the grey matter of one side only.

Though this kind of hæmorrhage is, in contradistinction to the others, spoken of as primary, yet it is almost invariably preceded by some pathological changes in the vessels of the cord. These constitute the predisposing conditions, and the actual rupture takes place, rarely, when the person is at rest, but more frequently under the influence of some distinct exciting cause—such as muscular exertion of one kind or another.

Primary hæmorrhage, though rare, is most prone to occur in persons between the ages of twenty and forty, and not with increasing frequency as age advances. This constitutes a further notable difference between hæmorrhages of the spinal cord and those into the brain.

Symptoms.—These are necessarily subject to great variations, according to the amount of blood effused, and as the hæmorrhage takes place into the cervical, the dorsal, or the lumbar region respectively. The kind of variation thus induced may be gathered by reference to the article, Spinal Cord, Diseases of: § 7, (*a*), and § 8.

Here it is of importance to set forth the peculiarities (both as regards mode of onset and nature of the symptoms) which belong to hæmorrhage as compared with other pathological conditions of the cord. First, its tendency is to take place suddenly and without warning; and, secondly, for the blood to be effused into the grey matter for some distance, thus giving rise to a characteristic grouping of symptoms. There may, therefore, be a sudden onset of pain in the back (possibly severe), followed almost immediately by complete motor and sensory paralysis of the legs and trunk up to a certain level, together with complete paralysis of the bladder and rectum. At first there may be an abolition of all reflexes, and possibly a lowering of temperature in the legs; though after a day or two—should the injury be in the dorsal or lower cervical region of the cord —there may for a time be increased heat of legs, owing to vaso-motor paralysis, and a return, with some exaggeration, of various reflexes. Rapid atrophy, with the appearance of the electrical 'reaction of degeneration,' occurs in all muscles that are in immediate functional relations with the portions of the anterior cornua of the cord that may be damaged. Cystitis, together with sloughing bed-sores and all their consequences, tends to occur early, and that often in spite of all precautions that may be taken.

Where the hæmorrhage invades pretty fully, but is limited to, the grey matter of one-half of the cord, we may have groups of symptoms that take the form of *hemiplegia spinalis* or *hemiparaplegia*. *See* 2. Punctured or Gunshot Wounds.

Diagnosis.—The absolutely sudden onset of the paralysis, which may be complete in the lower extremities in the course of a few minutes (especially when associated with a sudden painful sensation in the back, or one which radiates into the limbs), as well as the almost complete and sudden loss of sensibility in the paralysed parts, form a group of symptoms which are typically distinctive of hæmorrhage into the grey matter of the cord.

The condition most likely to be confounded with it is a large *hæmorrhage outside the dura mater*, causing compression of the cord. Here the onset would also be sudden, but almost invariably associated with some mechanical injury or shock. The paralysis of motion, too, would generally be much more marked than the interference with sensibility. The subsequent progress of such a case would further tend to separate it from a case of intra-medullary hæmorrhage, since (even with a severe meningeal hæmorrhage in the cervical region), if the patient should survive the first effects of the lesion, the symptoms might be expected soon to grow less and less urgent, and recovery may be more or less complete. No such amelioration is, however, to be expected in the case of a well-marked hæmorrhage into the grey matter of the cord, in the cervical region or elsewhere.

On the side of the brain *embolism* is capable of initiating paralytic symptoms with as much suddenness as a hæmorrhage, but in the spinal cord, for reasons previously stated, this does not occur. *See* Spinal Cord, Diseases of: § 5, 8.

It does, however, happen occasionally that a process of softening—probably caused by *thrombosis*—has its occasioning conditions initiated suddenly. When this occurs, paraplegia sets in almost as abruptly as if it were produced by hæmorrhage; but then it is usually an incomplete paraplegia, and, for a time at least, unaccompanied by loss of sensibility. In the course of a few days, in such a case, sensory paralysis may supervene, and the motor paralysis may become more complete. In the exceptional cases of paraplegia of sudden onset due to this cause, there is generally no initial pain in the back, though there may be pains and burning sensations in the limbs.

Prognosis.—Where the hæmorrhage is at all large, so as to extend through the grey matter for the distance of an inch or more, the prognosis is always grave. Very few of such cases recover. They are, in fact, liable to be aggravated by the establishment of a secondary process of softening in the grey matter, which may slowly extend both above and below the blood-clot as well as around it. Should this softening reach far into the cervical region, or should the hæmorrhage itself implicate this part of the cord, the patient may not survive more than a few days. But if the primary and secondary pathological changes are limited to the lumbar or to the dorsal region of the spinal cord, the fatal event is usually brought about more slowly, after an interval of weeks or perhaps even of months—and then commonly from the occurrence of sloughing bed-sores, together with cystitis and other frequent accompaniments of a severe paraplegia.

In the case of small hæmorrhages limited to some fractional part of the transverse area of the cord, and of slight longitudinal extent, the prognosis is, of course, much more favourable, and there is no reason why partial recovery, at least, may not occur.

Treatment.—In the treatment of a case of spinal hæmorrhage, should the patient be seen immediately after its occurrence, absolute quietude, with rest in the recumbent or prone posture, should be ensured.

Bleeding, either local or general, is useless. Purgatives also are contra-indicated.

Should the pulse be full, and the heart's action excited, decided benefit may be derived from 10-minim doses of tincture of digitalis, in combination with 15 or 20 grains of bromide of potassium, given for the first three doses at intervals of three or four hours, and subsequently every six or eight hours, for two or three days. These drugs will also favour sleep, and exercise a general calmative influence.

Position and rest are perhaps the means to be principally relied upon to prevent a recurrence or continuance of the hæmorrhage ; such measures may be supplemented by warm applications to the feet and calves of the legs; though the patient should in other respects be kept perfectly cool. Ice to the spine may be applied, but is of doubtful utility. Spoon-diet should be strictly enjoined for a few days at least.

The patient's urine will require to be drawn off by catheter; and extreme care ought to be taken to ensure its antiseptic cleanliness. After a day or two, if the bowels have not been moved, a laxative or an enema should be administered, since, as in many other forms of paraplegia, there may, at first, be obstinate constipation rather than incontinence of fæces.

Subsequently, the case requires to be treated in all respects like any other very bad case of paraplegia—extra precautions being observed throughout, in order, as far as possible, to guard against the onset of bed-sores and cystitis. Fuller details concerning such treatment will be found under 9. Softening, since this is by far the most common cause of paraplegia.

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9. Spinal Cord, Softening of.—Synon.: Non-inflammatory, White, or Simple Softening; *Myelomalacia*; *Mollities Medullæ Spinalis*; Acute Myelitis (in part); Compression Myelitis (in part); Fr. *Ramollissement de la Moelle Épinière*; Ger. *Erweichung des Rückenmarks.*

Nature of Change. — The writer has already intimated his opinion that far too large a share is assigned to inflammation in the pathogenesis of diseases of the spinal cord. This mistake is particularly obvious in regard to acute inflammations. It has long been the fashion to speak of almost every focus of 'softening' that occurs in the spinal cord as being the result of an 'acute myelitis'; and we find even Erb (in Ziemssen's *Cyclopædia*, vol. xiii.) putting forward, as characteristics of an inflammatory softening, peculiarities which certainly ought not to be regarded in such a light—and this although he seems otherwise strongly inclined to hold a similar opinion to that above expressed. Whilst admitting that a true myelitis is not distinguishable macroscopically, in the great majority of cases, from a simple or non-inflammatory softening, Erb adds a statement to the effect that the 'microscopical examination can alone furnish conclusive evidence.' In the opinion of the writer, however, such evidence as that which is cited by Erb (*loc. cit.* p. 470) is quite inconclusive.

It is evident, indeed, that we are still almost as destitute of microscopical as we are of macroscopical characters, of a trustworthy description, for enabling us to decide whether any given focus of softening has been of inflammatory or of simple non-inflammatory origin. Such researches as those of Hamilton (*Quart. Journ. of Micros. Science*, Oct. 1875) and others must be prosecuted further and multiplied before any certain means of deciding such a question can exist. In the early stages, or on the confines of a focus of inflammatory softening, we may expect to find a very distinct infiltration of the tissues with leucocytes, which would, of course, at once give a key to the true nature of the change in question.

In the present state of knowledge, however, it would appear that the 'non-inflammatory softenings' of the cord are represented by the great majority of the primary and apparently idiopathic 'softenings' which frequently occur in this organ.

Ætiology and Pathogenesis.—Concerning the ætiology of non-inflammatory softening of the spinal cord, it is impossible to speak positively. The disease presents itself as a spontaneous or idiopathic affection, sometimes without apparent cause or definite antecedent conditions of any kind, but at others as a sequence of one or other of various known and common precursors of diseases of the spinal cord.

Thus in certain cases the symptoms set in more or less suddenly after some great bodily fatigue; in others after extreme sexual excesses; or they may occur during the period of convalescence from certain acute fevers, such as variola, typhus, and other exanthemata, or after rheumatic fever. During the first week or two after childbirth there is likewise a liability to such symptoms; and also in the later stages of syphilis. These different conditions may act very variously in contributing to bring about a focus of softening in the spinal cord, and nothing more than conjectures can be advanced in regard to its pathogenesis in the several cases. It may be recognised, however, that most of them tend to entail cardiac weakness, either alone or in association with blood-changes which may favour the occurrence of thrombosis.

Again, the symptoms indicative of a primary softening of the cord may set in after the action of other conditions, regarded by some as exciting rather than as predisposing causes. Of these the following may be enumerated: Prolonged exposure to cold and wet; sudden suppression of the menses or of other accustomed fluxes; violent emotional disturbances; or the existence of some inflammation in one or other of the pelvic organs, such as the uterus or the bladder and urethra (instances of the latter class being some of the cases formerly supposed to be of 'reflex' origin). In regard to these 'exciting causes,' all that is certainly known is, that softening of the cord seems to set in not infrequently in persons who have been subjected to one or other of them; but in what precise mode either of them is related to the subsequent softening, nothing very definite can be said. Something, nevertheless, may be advanced by way of suggestion, with the view more especially of giving direction to the investigations needful for clearing up this subject.

Spinal and cerebral softenings probably own a similar mode of origin. Of the obstructions of vessels which so largely determine cerebral non-inflammatory softenings, it is those due to thrombosis, rather than to embolism, which intervene in the main for the production of corresponding conditions in the spinal cord. *See* Spinal Cord, Diseases of: § 5, (8) and (9).

It is well known that the causes of thrombosis are principally three, and that in different cases, now one, now another of them may be most influential; whilst in other instances two or more of these causes may cooperate. These three causes are—(*a*) thickenings, irregularities, or degenerations of the inner coats of the vessels; (*b*) slowness of blood-current; (*c*) peculiarities in the chemical composition of the blood, rendering it more than usually prone to coagulate.

The thrombosis may take place in the arteries or in the veins, and the plexiform arrangement of the spinal vessels, together with the slowness of their blood-current, may favour the occurrence, as well as the spread of the process when it has once been initiated. Thus a process of coagulation, beginning, perhaps, in some very small vessel, may gradually extend so as to involve many other contiguous branches, and thereby gradually increase the area of the cord which is deprived of its proper blood-supply. The small size of the vessels, however, makes it extremely difficult to establish the fact of their occlusion, whereas in the large vessels at the base of the brain thrombosis is easily enough detected. And it is especially worthy of note, in this connexion, that the blood-supply of the lower end of the cord (where primary softenings are most common) is peculiar and easily interfered with. To this important point Dr. Moxon called attention (*Brit. Med. Journ.*, vol. i., 1881). In short, the anatomical conditions existing in the cord, both on the arterial and on the venous side of its circulation, are probably of a kind distinctly to favour the occurrence of thrombosis.

Anatomical Characters.—In regard to their distribution or extent in the cord many varieties of softening exist which have been commonly recognised, though they have been mostly described under corresponding designations as so many varieties of 'myelitis.' Thus, we may have a 'complete transverse softening,' involving the entire thickness of the cord for a variable longitudinal extent, either in the lumbar, the dorsal, or the cervical region. Or the softening may be more limited to certain subdivisions of the cord in one or other of these regions—and then constitute an 'incomplete transverse softening.' Thus it may, in one set of cases, principally affect the anterior columns and grey matter; in another set the posterior columns and more or less of the grey matter. Or the softening may be central, and almost confined to the grey matter through a considerable extent of the cord, as in 'diffuse central softening'; when this change involves the white columns as well as the grey matter for a considerable extent, we have what is called 'diffuse softening' of the cord. When a small focus of softening exists which only involves part of the transverse area of the cord, and that for a very limited extent, we have what is commonly spoken of as a 'circumscribed softening' of the cord; and where many of these small foci are scattered through different parts and regions of the organ, we have what is known as 'disseminated softening.'

An accidental damage during the opening of the spinal canal must not be confounded with the results of pathological change. In a spinal cord bruised in the manner indicated the nerve-substance may be softened and diffluent, and somewhat resemble a patch of real pathological softening. Examination with the microscope, however, would show, amongst the fragments of myeline from the broken nerve-tubules in the former case, an entire absence of the large granulation-corpuscles, which are, on the contrary, invariably present in a patch of real pathological softening. If there were, after such an examination, still room for doubt, this might be resolved by the fact that the softened nerve-matter in a patch of real softening of the cord, has its specific gravity lower by 3–5 degrees than that of other healthy portions of the organ, whilst in the patch of merely bruised nerve-substance it would not be appreciably lower than normal. The normal specific gravity of the spinal cord varies commonly from 1033–1041 in different individuals—the higher figures being most frequently met with in elderly persons. The modes of estimating the specific gravity have been discussed by the writer in *Journ. of Ment. Science*, vol. xi. 1866.

Where the process of softening has gone on to its final stages—in a case, for instance, of 'complete transverse softening'—the whole substance of the cord in the affected site is reduced to a rather dirty-looking milky fluid, which, when the membranes are cut across, flows out so as to leave a complete gap in the cord-substance for an extent, it may be, of one to three inches. All intermediate stages may be found between such a condition and a slight degree of softening, in which the cord-substance is only a little more pulpy than natural.

SYMPTOMS, COURSE, AND TERMINATIONS.—The symptomatology of this disease presents an extremely wide range, in accordance with the varying extent and sites of the softening in the cord, as existing in different patients.

In 'circumscribed' and 'disseminated' softening, for instance, the symptomatology would be excessively variable in different patients; and, especially in the latter class of cases, it might be extremely difficult to arrive at a diagnosis. The symptoms could, in fact, only be interpreted by the light of the general principles applicable to the regional and pathological diagnosis.

Again, in cases of 'diffuse central softening' the symptoms—except for the fact that they set in gradually rather than abruptly—would bear a close resemblance to those of hæmorrhage into the spinal cord, where the blood is effused into the central grey matter for a certain extent (*see* 8. SPINAL CORD, Hæmorrhage into). There is some doubt, indeed, whether these latter cases may not occur principally as epiphenomena sequential to a primary central softening.

The symptomatology of 'incomplete transverse softenings' of the cord is for the most part exemplified by the second stages of various forms of so-called 'compression myelitis'—cases, that is, in which the anterior regions of the cord more especially are, in one set of cases, principally pressed upon either by tumour, or by the inflammatory products associated with vertebral caries ('Pott's disease'); whilst in another set the posterior columns and posterior grey matter may undergo a similar softening, under the influence of the pressure of a new-growth impinging upon the cord from behind. Cases of this type, however, may easily and do often merge into 'complete transverse softening' (commonly known as 'complete transverse myelitis'). Both complete and incomplete forms also often occur in the cord quite independently of pressure.

Of these states it will be well, for the sake of brevity, to confine our attention principally to '*complete transverse softening*.'

In a case of *complete transverse softening* involving the mid-dorsal region, the temperature in the axilla usually varies between 98° and 100° F., though with an extension of the pathological process, or towards the close of the disease, it may rise to 101°, 102°, or even higher. Meanwhile the lower extremities themselves are often distinctly cold to the hand—the temperature being in some cases more or less subnormal. It is important to note this, because it might have been supposed that hyperæmia and a slightly elevated temperature would exist, owing to the vaso-motor nerves of the limbs being paralysed.

The motor paralysis of the lower extremities is absolute, and the abdominal muscles are also powerless. The feet, as the patient lies in bed, are extended and often inverted, so that the great toes cross one another. The skin after a time tends to become dry and scurfy. The muscles feel flabby to the hand, but they waste only to a slight extent, and continue week after week to show only a small amount, if any, of diminution in the degree of their irritability to faradic and to galvanic currents.

The sensibility of the limbs is completely abolished both for tactile and painful impressions, as well as for differences of temperature and tickling. A like abolition of sensibility exists over the trunk up to the level of the 'ensiform area,' whilst above this level the sensibility is found to be quite natural. Though the upper limit of anæsthesia may be quite sharply defined, yet in these cases of complete transverse softening there is often no distinct 'girdle-sensation.'

The muscles of the lower extremities may show some slight irritability when they are forcibly tapped, and when the soles of the feet are strongly tickled there may be very slight movements of the toes; but beyond this there is often an entire absence of all reflex movements—there is no ankle-clonus, no knee-reflex, and a similar absence of the cremasteric and abdominal reflexes.[1] In the initial stages of the affection, however, and especially when the softening is not completely transverse, all these reflexes may be extremely well-marked for a time, though they tend gradually to diminish.

For the first ten days or a fortnight there is often complete retention of urine, but after this time, when the lumbar region of the cord again becomes capable of manifesting to some extent its centric functions, the initial retention gives place to incontinence of urine. This fluid may be discharged at intervals of two to three hours in small quantities, owing to the occurrence of reflex contractions of the bladder whenever the organ attains a certain degree of fulness. The passage of a catheter, however, in these cases will often show that the bladder is never completely emptied — two to four ounces remaining after the reflex contractions. Unless special precautions are taken, the urine, in such patients, speedily becomes ammoniacal, and more or less loaded with mucus.

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[1] In one case in which paraplegia had existed for over three months, in consequence of a complete transverse softening in the upper dorsal region (with the above-mentioned clinical signs), the writer was much struck with the extremely pallid appearance of the grey matter through the whole length of the cord below the seat of softening. The absence of the reflexes may be in part due to such condition of the grey matter, and this itself may be caused by a spasm of its vessels in some way induced by the lesion above. Some amount of spasm may also exist in the vessels of the limbs, whose temperature is often rather sub-normal. *See* a paper by the writer on 'The Symptomatology of Total Transverse Softening of the Spinal Cord,' in *Med.-Chir. Trans.*, vol. lxxiii., 1890.

The bowels are usually constipated, and relieved only after the administration of aperients or enemata. At these times there is generally incontinence of fæces — the patient having no power of controlling the reflex actions concerned in defæcation when they have once been strongly excited. The actual passage of the motion is, moreover, unfelt.

Under the irritative influences emanating from the seat of softening during the period of its establishment, a small bed-sore may begin to form, often amenable to treatment. Later on, sloughs are prone to appear upon the heels, over the malleoli, and in other situations habitually exposed to continuous pressure. But the most frequent site for intractable sloughing bed-sores is over the sacrum. Inflammation of the mucous membrane of the bladder is at last set up; and the inflammation may extend up one or both ureters, so as to implicate the pelvis of the kidney, when minute abscesses may also form in the kidney itself.

Under the influence of these various conditions the patient's appetite and strength gradually fail; emaciation proceeds; and death after a time may come from sheer exhaustion, aided, perhaps, by some intercurrent inflammatory affection of the lungs. Such complications may, however, be occasionally warded off for eighteen months or more. Other modes of death are pointed out in the section on Prognosis.

Diagnosis.—The recognition of this disease at the bedside often presents considerable difficulties. We must be guided partly (*a*) by the patient's history and state; partly (*b*) by the mode of onset of the disease; and partly (*c*) by the symptoms of the fully established affection.

(*a*) The points in regard to previous history which are of principal significance are referred to under the head of Ætiology. In regard to (*b*), the mode of onset, this is usually not abrupt and sudden; there is rather a slow increase of paralysis during a week, ten days, or a fortnight. Still, it is a fact that softening of the cord (apparently due to thrombosis) does occasionally cause a sudden incomplete paralysis, though such paralysis increases subsequently in the manner above stated. Such a case must not therefore be confounded with hæmorrhage into the cord, merely by reason of its absolutely abrupt onset.

The extent to which the diagnosis turns upon (*c*), the nature of the symptoms of the fully established affection, cannot be very strictly defined except in some cases. When the softening is slight and partial, it gives rise to no distinctive symptoms; but where there are clinical signs of the existence of a complete transverse lesion, the chances are that the lesion itself is, if not a primary, at all events a secondary softening.

In regard to the *regional diagnosis* of softening of the spinal cord, the following points require to be borne in mind:—

The indications as to the transverse area involved, and as to the upper limits of the change in the spinal cord, are wholly derivable from the presence or absence of the various signs and symptoms which have been set forth in the article, Spinal Cord, Diseases of: § 7, (*a*), and § 8.

The attempt to ascertain the lower level of the lesion, and consequently its longitudinal extent in the cord, is always difficult, and often cannot be achieved with any success. The indications are all obscure, uncertain, and apt to fail. This is especially the case if we attempt to base an opinion on the fact of the existence or absence of superficial reflexes (*see* § 4, (*a*)). Thus, complete transverse softening may exist in the upper dorsal region, and extensive secondary degenerations may have been produced, yet for week after week there may be a complete absence of all the reflexes, superficial and deep, dependent upon the cord below the upper dorsal region. This the writer has ascertained by repeated clinical examinations of cases whose nature has been subsequently verified *post mortem*.

Prognosis.—The prognosis in a case of paraplegia must always involve a twofold problem: (1) as to the duration of paralysis, or the probability of recovery; (2) as to the danger to life.

(1) The chance of ultimate recovery from paralysis would vary inversely with the size or extent of the lesion existing after the first ten days or a fortnight—that is, by the time softening has been unmistakably established, and when the chance of such an event being warded off by the establishment of a collateral circulation no longer exists. But where a pretty complete reinstatement of blood-supply does take place, all symptoms of paralysis may gradually disappear in the course of some weeks, or, it may be, months.

(2) Danger to life is brought about in many ways, and a fatal result may be entailed (*a*) by a gradual extension upwards of the process of softening (especially where it exists in the lower cervical or upper dorsal

region) so as to involve paralysis of the diaphragm, or an extreme interference with the heart's action. (*b*) Inflammation of the bladder, followed by implication of other portions of the urinary tract, may lead on to death after the paralysis has lasted for some months, or perhaps not for a year or two. (*c*) About the same period (sometimes early and sometimes late) extensive bed-sores may form, and the patient may, after a time, die exhausted, or from blood-poisoning. (*d*) Again the supervention of an intercurrent pneumonia may lead on to a fatal result; or (*e*) the end may come from the extension inwards of the process of sloughing, so as to lead to the establishment of a rapidly fatal spinal meningitis. Still in some cases, as above indicated, the patient may remain paralysed for even two years or more before a fatal termination is brought about.

Treatment.—Our power to deal with the softened condition itself of the spinal cord is extremely small, whether it may have been caused by thrombosis or by compression. During the early stages probably the less that is done in the way of active interference the better. The principal indications are that the patient should have absolute rest in bed, and for the first few days at least a rather sparing diet; spoon-diet being desirable where distinct elevation of temperature exists. The secretions should be regulated, and the urine, if necessary, drawn off by a thoroughly clean catheter smeared with carbolised oil, and kept in the intervals in a bichloride of mercury solution. Sedatives, such as bromide of potassium, either alone or in combination with chloral, may be needed at night, for a time, so as to ensure an adequate amount of sleep.

Should the patient's general health be weak or deranged, as is so often the case, every effort must be made to improve it by means of an easily assimilable but generous diet, gradually increased, and by the exhibition of suitable tonics, with or without small doses of cod-liver oil. It is far better to trust to such general means than to the supposed influence of phosphorus, or any other drug. To expect any of them to have a direct influence in restoring softened nerve-tissue is vain; and any good that may be achieved by drugs alone is probably brought about either by their power of regulating some of the principal functions of the body, or by improving its nutritive processes generally.

Still scarcely any morbid condition exists in which more constant care and vigilance are needed than in the *paraplegic state*, in order to correct or ward off its numerous incidental troubles or complications.

One of the first points claiming attention in the early stages of a case of paraplegia is to take such measures as will stave off the occurrence of bed-sores as long as possible. These precautions are especially needful where the paraplegia is complete, and where loss of sensibility exists. The patient should at an early stage of the disease be placed upon a water-bed; and those forms are most suitable in which there is a canal through centre the for the passage downwards of the evacuations. The patient must be kept scrupulously clean and dry; and no folds of the bed-clothes must be permitted to press against the skin. If possible, the patient should not be allowed to lie habitually upon his back, but occasionally in a prone or lateral position. The skin over the sacrum especially must be carefully watched, and on the least sign of a patch of undue redness there, it should be rubbed once or twice a day with a mixture of equal parts of olive oil and spirits of wine. If it becomes actually abraded, it should be dressed with zinc ointment, smeared over a piece of soft lint.

For the first fortnight or more there may be complete retention of urine, which then requires to be drawn off night and morning by catheter. During this period the greatest care should be taken in regard to the cleanliness of the catheter employed. Carelessness in this respect will tend to bring on cystitis at an early date, with alkalinity of urine, and may thus quite prematurely aggravate the bladder-troubles. As soon as the bladder begins to empty itself again, in a reflex manner, at intervals throughout the day, the use of the catheter may be discontinued as long as the water which comes away continues to be clear and acid. During this period of incontinence it will be necessary to draw off the urine from time to time for the purposes of examination. As before stated, the bladder never completely empties itself. After this state of things has continued for some months, the urine is apt to become alkaline, ammoniacal, and more or less mixed with mucus. At this stage the bladder should again be emptied once or twice daily, and washed out each time with 6 to 8 oz. of quinine solution (2 grains to the ounce, with enough of diluted sulphuric acid to dissolve it); or with a 2 per cent. boric acid solution. This will prove the best means of warding off or of mitigating inflammation of the bladder; and thus perhaps of preventing its extension to the ureters and kidneys.

In regard to the bowels, purgatives will probably be required from the first, as without their use there will be no evacuation. Sometimes a simple enema will suffice. Scybalæ tend to accumulate in the large intestine, unless its contractility is aroused occasionally by a large injection, consisting of three pints of warm thin gruel, together with half an ounce of spirit of turpentine and an ounce of castor oil.

Where the disease has reached the chronic stage, and when death is not inevitable, the muscles should be faradised or galvanised three times a week, whilst massage may be employed on alternate days, with a view to maintaining their nutrition as far as possible.

When in the final stages of paraplegia large and sloughing bed-sores have formed, they will require the most constant care and attention. Poultices may be at first needed till the sloughs have separated, and afterwards the wounds must be variously dressed according to their condition. An ointment composed of ten grains of carbolic acid to one ounce of vaselin may be employed; or more stimulating applications may be needed. Sometimes iodoform or the iodide of starch paste forms a suitable dressing.

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10. Infantile Paralysis.—*See* PARALYSIS, INFANTILE.

11. Acute Spinal Paralysis of Adults.

SYNON.: *Poliomyelitis Anterior Acuta*; Acute Inflammation of the Grey Anterior Horns; Acute Atrophic Spinal Paralysis; Fr. *Paralysie Spinale Atrophique Aiguë*; Ger. *Poliomyelitis Anterior Acuta*; *Acute Spinallähmung bei Erwachsenen.*

This is essentially the same disease as that known as infantile paralysis (*see* PARALYSIS, INFANTILE), though presenting certain differences from the fact of its occurring in adults. Its existence, however, was not distinctly recognised till about the year 1865, when illustrative cases were published almost simultaneously by Duchenne and Moritz Meyer. Now that observers have been on the look-out for it, it has proved to be one which is by no means uncommon, although it is very much rarer than the similar affection in infancy or early childhood. The disease is more difficult to recognise in adults, because in them other affections occur with which it is quite possible that it may be confounded.

ÆTIOLOGY.—The ætiology of this affection in adults is just as obscure as it is in children. Sometimes it manifests itself without any assignable cause; whilst at other times there is the possibility that exposure to wet and cold, some shock or blow, or some antecedent acute febrile illness may have had to do with its origin. The causative conditions are, in fact, in part similar to those of multiple neuritis (*see* NEURITIS, MULTIPLE), and the two affections in different proportions sometimes co-exist. There exists, perhaps, in some persons a special vulnerability or instability of the motor ganglion cells of the grey matter of the spinal cord. To this view Bernheim inclines (*Rev. de Méd.*, Jan. 1893), in consequence of his having collected nineteen cases in which persons who have suffered from infantile paralysis have in adult age become affected either with acute, subacute, or chronic poliomyelitis—sometimes involving the same and sometimes different regions of the spinal cord.

SYMPTOMS.—It will principally be necessary in this place to point out the manner in which the group of signs and symptoms characteristic of the disease in infancy becomes modified when it occurs in the adult.

The first set of differences is due to the minor irritability of the nervous system in the adult, as compared with that of the young child. The initial febrile symptoms may be so slight as to escape notice; convulsions have never been met with; and preliminary head-symptoms are generally absent or very slight. Still some headache, or mental dulness, may be present; and vomiting occurs not infrequently.

Paralysis then sets in speedily—it may be within a few hours—and is more or less widespread. The muscles are flaccid; reflex actions are abolished or greatly diminished. In the course of a few days, generally, improvement as regards motor power sets in, and very slowly progresses. It may go on continuously to complete recovery in the course of a few months; or, as often happens, such recovery is only partial. In the latter case certain muscles or groups of muscles remain paralysed, and in them a rapid atrophy occurs. When tested electrically, these muscles exhibit the 'reaction of degeneration.' The affected parts are cold, and sometimes more or less cyanotic. There is no impairment of sensibility; and no interference with the functions of the bladder or rectum.

All the characters mentioned in the last paragraph accord with those which present themselves in infantile paralysis, but later on differences again show themselves. One of the characteristic features in the child is arrest of growth in the parts affected, so that the limbs or parts of limbs paralysed remain more or less abortive. This, of course, cannot occur in the adult; and also, owing to the fact that the joints are stronger, the secondary deformities (often so serious in the child) are not met with to the same extent in adults.

DIAGNOSIS.—The mode of onset of the disease; the fact that the paralysis is purely motor, associated with no pain or tenderness, and accompanied by no interference with sensibility; the fact that after the first few days at least the functions of the bladder and rectum are not interfered with; and also that in later stages there is atrophy of muscles, and the existence of the electrical 'reaction of degeneration'—these constitute a group of conditions which, taken as a whole, is thoroughly distinctive.

The disease with which it is most liable to be confounded is that hereafter to be described (*see* 13. Spinal Paralysis, Chronic Atrophic). The points of distinction will, therefore, be given under it. 'Progressive muscular atrophy,' if we bear in mind its very chronic onset, is much less liable to be confounded with the present disease, as also if we recollect that in it atrophy makes its appearance before paralysis rather than after, and that the electrical reactions are, except in the later stages of the disease, notably different.

The fact of the absence of spasms, the diminution of reflexes, the non-interference with sensibility and with the sphincters, together with the abrupt origin of the disease, suffice to separate the acute spinal paralysis of adults from all other affections of the spinal cord, though not from all cases of multiple neuritis. As to this latter difficulty, the reader may refer to the section on Diagnosis in the article on NEURITIS, MULTIPLE.

PROGNOSIS.—This is not a disease dangerous to life. Complete recovery not infrequently takes place, and that too, as the writer has seen, where the paralysis may have been widespread, affecting all the limbs for a time, and leading to marked atrophy in the muscles of the lower extremities. In other cases there is left in particular parts a chronic remainder of paralysis with atrophy, just as we find to be the case in children. In so far as any part of the patient's symptoms are due to some co-existing peripheral neuritis, we are generally entitled to make a more hopeful forecast.

TREATMENT.—This disease must be dealt with on precisely the same principles as those which are applicable to the corresponding affection in young children. Repetition is, therefore, here unnecessary. *See* PARALYSIS, INFANTILE.

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12. Acute Ascending Paralysis.

—SYNON.: *Paralysis Ascendens Acuta*; Landry's Paralysis; Fr. *Paralysie Ascendante Aiguë*; Ger. *Paralysis Ascendens Acuta.*

DEFINITION. — A mysterious affection of the spinal cord, first definitely described by Landry in 1859; characterised on its clinical side by the existence of a progressive paralysis, advancing rapidly from below upwards, so as finally to implicate parts dependent for their innervation upon the medulla oblongata; characterised also on its anatomical side by the absence of any appreciable pathological change.

On account of the latter peculiarity, the disease ought not to be described in the present place, but rather to constitute the first of Class II. (*see* p. 814). But this disease, together with 'acute spinal paralysis' and 'subacute spinal paralysis,' have such an amount of similarity from a clinical point of view, that it seems very desirable for their descriptions to follow one another, so that mutual alliances as well as differences may be the more distinctly appreciated.

ÆTIOLOGY AND PATHOLOGY.—The causes and pathogenesis of this affection are even more obscure than those of the disease last referred to. Exposure to cold, and emotional disturbances (with or without suppression of menstruation in the female) have been observed occasionally as precursors. Occasionally, too, this disease has supervened during convalescence from some previous acute febrile malady, such as small-pox or typhoid fever. Syphilis is thought by a few (but on no sufficient evidence) to have something to do with the pathogenesis of this affection. Westphal, again, who pointed out that the spleen became enlarged in this affection, inclined to believe in the existence of some toxic influence—a view in support of which there is more in the way of evidence. The disease seems principally to occur in persons between the ages of twenty and forty, and to be decidedly more frequent in males than in females. Although the brain and spinal cord of those who have died from this affection have now been frequently examined by skilled observers, the results have hitherto been almost entirely negative, so far as morbid anatomy is concerned. No definite changes have, moreover, been met with in the peripheral nerves with any constancy, though the predisposing influences and the symptoms are such as to have created a strong suspicion that the affection might be due to a multiple neuritis. Further evidence is, however, needed before definite conclusions can be arrived at as to the exact nature of this very puzzling malady.

SYMPTOMS, COURSE, AND TERMINATIONS.—About the prodromata there is nothing distinctive—they may be absent. When present there may, for a few days, or even for a few weeks, be a slight febrile condition from time to time, with a sense of weariness, and more or less numbness in the limbs, especially in the tips of the fingers and in the feet.

The disease then more definitely declares itself, and follows a very variable course as regards rapidity of evolution; sometimes causing a generalised paralysis which may prove fatal on the second or third day, and at other times lasting as many weeks before death occurs, or recovery sets in. The disease commences by a marked weakness of the lower extremities; soon to be followed by actual paralysis, which, as in the 'subacute and chronic spinal paralysis,' shows itself first in the distal portions of the limbs, and gradually approaches the trunk, so that in the course of two or three days, or even much less time, the paralysis of the lower extremities becomes complete.

The trunk muscles are next, and soon, implicated in a similar manner. The patient can no longer sit up or turn in bed. Respiration becomes more and more affected, and defæcation is interfered with, through weakening of the abdominal muscles.

Next, though sometimes after a distinct interval, the upper extremities become implicated; though here again the paralysis first involves the distal portions of the extremities, and thence gradually spreads (after a period in which mere paresis exists), till the whole limbs become completely powerless.

The paralysed limbs, both upper and lower, are lax, and show no trace of contraction. Though the muscles are flaccid, they *do not undergo* a *marked* amount of *atrophy*, as is the case in 'acute spinal paralysis.'

In accordance with this latter peculiarity, there is the further striking characteristic that the *electrical reactions of nerves and muscles continue perfectly normal.* This seems now to be a well-attested fact, and it has been verified by good observers even after complete paralysis (without atrophy) has existed, in the more chronic cases, for several weeks.

Sensibility is scarcely, if at all affected; nor, as a rule, are pains complained of in the paralysed parts.

The reflexes, both superficial and deep, are generally abolished, though in the more chronic cases they may reappear after a time.

The nutrition of the skin is not impaired, so that there is no tendency to the formation of bed-sores. Coldness and cyanosis of the limbs do not seem to be characteristics of this affection.

The sphincters are usually not at all affected. Constipation is often marked, and defæcation may be rendered difficult owing to paralysis of the abdominal muscles.

As a rule, there is no febrile elevation of temperature, though to a slight extent this has been present in some cases.

At the stage above indicated, in nearly one-third of the recorded cases, or it may be even before the arms have become much implicated, the disease becomes arrested, and after a brief interval recovery of power begins to manifest itself—usually in a reverse order, so that power is regained first over the arms, then over the trunk, and subsequently (and perhaps only in the course of several weeks) over the lower extremities.

But in the remaining two-thirds of the cases, after the arms have become paralysed, the disease still progresses so as to affect the cervical muscles, the diaphragm, and finally the muscles innervated by the motor nerves of the medulla. Thus, in its later phases the disease is characterised by a greatly increasing difficulty in respiration; great weakness of voice; extreme rapidity of pulse; and possibly by inequality of the pupils. Finally, increasing paralysis of the muscles concerned with articulation and deglutition sets in; and, owing to the augmenting difficulties of respiration, death may arrive at any moment by asphyxia. This climax of the disease may be reached in the course even of three or four days; on the other hand, it may not be reached until as many weeks have elapsed. Whenever the disease has advanced so far as seriously to implicate the medulla, recoveries are comparatively rare.

In quite exceptional cases the disease may pursue a reverse order throughout; implicating the nerves of the medulla first, then those of the cervical region of the cord, and so on. The celebrated Cuvier is said to have died from the disease progressing in this very unusual manner.

Diagnosis.—So far as the established disease is concerned, we have in this affection, in 'acute spinal paralysis of adults,' and in subacute forms of 'chronic spinal paralysis,' maladies that present certain well-marked points of similarity. In each we have to do with simple motor paralysis, with no fever, no tenderness or pains in the spine, no pains in the limbs or contractions, and with no incontinence of urine or fæces, or tendency to the occurrence of bed-sores.

'Acute ascending paralysis' differs from both these affections, however, in the important fact that rapid atrophy does not set in in the paralysed muscles, and that the electrical reactions in no way differ from those met with in healthy nerves and muscles. In the very acute cases, of a few days' duration only, these distinctions would be worthless, as sufficient time would not have elapsed to make it possible for either of them to occur. In such rapid cases, therefore, the distinctly *progressive* character of the disease is that which will serve to distinguish it from the more severe cases of 'acute spinal paralysis,' in which the paralysis sets in simultaneously throughout the whole of the parts affected (the area of the paralysis subsequently tending to diminish), and often with a pretty distinct initial febrile disturbance. Then, again, there is the fact that this latter disease has no tendency to involve the medulla, and is only very rarely fatal.

It is in the diagnosis of the more slowly evolved forms of 'acute ascending paralysis,' from the similarly progressive cases of 'chronic spinal paralysis,' that the development of rapid atrophy of the muscles, together with the 'reaction of degeneration,' comes to be distinctive of the latter affection. Again, in 'acute ascending paralysis' there is a longer persistence of reflex actions; and a far greater tendency to the manifestation of symptoms showing that the medulla oblongata is involved.

Prognosis.—Nothing can be added concerning prognosis beyond what has been above indicated in speaking of the course and terminations of the disease. It seems the rule that, the more rapid the progress of the disease, and the earlier the medulla is affected, the more is a fatal termination to be feared. Still, even in the most acute cases, improvement *may* take place.

TREATMENT.—The absence of any known pathological substratum for this disease makes it extremely difficult to lay down any directions for treatment. It would appear that we have to do with a simple alteration of the molecular condition of some parts of the spinal motor nerve-centres, unaccompanied by any known inflammation or irregularity of vascular supply.

Under these circumstances, the patient should be put upon a nutritious but easily assimilable diet, with a fair amount of stimulants; and, further, we may endeavour to induce a change in the nutritive and functional activity of the spinal cord, by having recourse to frictions of the skin or gentle shampooing of the limbs, together with brief daily applications of weak faradic currents to many of the affected muscles.

From drugs, perhaps the best chance of beneficial results may be looked for from combinations of iron and arsenic, or from the cautious use of small doses of strychnine. Iodide of potassium would probably be useless. H. CHARLTON BASTIAN.

13. Spinal Paralysis, Chronic Atrophic.—SYNON.: Subacute and Chronic Inflammation of the Grey Anterior Horns; *Poliomyelitis Anterior Subacuta et Chronica*; Fr. *Paralysie Générale Spinale Antérieure Subaiguë*; Ger. *Subacute Spinallähmung Erwachsener*; *Subacute Spinalparalysie.*

NATURE, ÆTIOLOGY, AND PATHOLOGY.—This disease was described by Duchenne in 1853, and then again more completely in 1872, as a more or less rapidly advancing motor paralysis, associated with atrophy of the muscles affected, and loss of their faradic excitability.

He believed the disease to be dependent upon a chronic degeneration occurring in the grey anterior horns, and this view is supported by the examinations which have as yet been made of persons who have been the subjects of this affection. The pathological changes in the anterior horns have been associated with atrophy of the anterior nerve-roots.

The causes of the malady are at present almost wholly unknown; but it occurs principally in individuals between the ages of thirty and fifty years. As with other chronic spinal affections, so here, there has often been one or other of the following events occurring some little time before the onset of the disease: Exposure to cold and damp, some shock or concussion, venereal excesses, or great fatigue induced by other causes. But what share the pre-existence of one or other of these conditions may have had in initiating the disease cannot at present be defined.

SYMPTOMS.—In the subacute cases, paralysis may become developed (usually in the lower extremities first) in the course of a few days or weeks; at the same time there may be some very slight initial febrile disturbance, and possibly some shooting pains in the back and limbs.

In the more chronic cases, the latter symptoms may be absent, and the onset of paralysis is very much slower. There may be at first mere paresis, felt most in the ankles and knees; but gradually (often after many months) this deepens into distinct paralysis of certain groups of muscles, or of the entire limbs. The muscles are flabby and progressively waste; at the same time they cease to respond well or even at all to the faradic current, and become more sensitive to the voltaic. There may also be notable fibrillar twitchings in the muscles undergoing this atrophic process.

Sensibility is unaffected. Skin and tendon reflexes are abolished. The temperature of the affected limbs is lowered; and the feet especially are apt to be more or less cold and cyanotic.

Soon the arms become affected in a similar manner, and here the paralysis may first affect either the extensors or the flexors. It may remain more or less limited to certain groups of muscles, or may gradually extend so as to implicate the whole limb. The distal parts are usually, however, more completely involved than the proximal. In the arms the same kind of phenomena occur as in the lower extremities, and there is a similar absence of rigidities or contractures.

There is no tendency to the formation of bed-sores, and the nutrition of the skin seems to be unimpaired.

The rectum, the bladder, and the sexual organs are usually quite unaffected.

After a time, the excessive reaction of the wasted muscles to the galvanic current decidedly diminishes; though in the earlier stages of this affection the electrical 'reaction of degeneration' often exists with all its characteristic details.

DIAGNOSIS.—This malady bears a closer resemblance to the 'acute spinal paralysis' of adults than to any other affection. The two diseases are naturally distinct in their modes of initiation, but as established diseases (that is, in their later phases) they would be very difficult to discriminate from one another in the absence of definite information as to modes of onset—and such information is often not to be obtained. It is the abrupt commencement of the paralysis over a wide area of the body that is met with in, and which is so distinctive of, 'acute spinal paralysis'; whilst in the subacute forms, and more especially in 'chronic atrophic spinal paralysis,' we have to do with a distinctly progressive spread of the disease from part to part.

In regard to the discrimination of these subacute and chronic forms of spinal paralysis from some other varieties of spinal cord disease, the reader may refer to what has been said concerning the grounds on which the diagnosis of 'acute spinal paralysis' is to be made. *See* 11. Acute Spinal Paralysis of Adults.

In the so-called 'amyotrophic lateral sclerosis' the upper extremities may be paralysed, wasted, and flaccid, as they are in 'chronic spinal paralysis'; but then in the former disease there may be the different combination of paralysis without wasting, but with more or less rigidity in the lower extremities.

For the distinguishing characters of 'acute ascending paralysis,' *see* the account of that affection, in the preceding article (No. 12).

PROGNOSIS, COURSE, AND TERMINATIONS.—In the subacute cases, after a month or two, improvement may gradually begin to manifest itself; and in exceptional instances this may go on slowly, but steadily, to complete recovery. In other of these cases, however, certain muscles or groups of muscles do not undergo the same improvement as the others; they may continue paralysed, and become more and more atrophied.

In the more chronic cases, recovery is scarcely to be looked for; though, after the symptoms have developed to a certain extent, it occasionally happens that no further advance is made. Such patients may remain in much the same condition for years.

In another class of cases the malady proves more continuously progressive, so that, after implicating the upper and lower extremities severely, the morbid process may extend to the upper cervical region of the cord, so as greatly to interfere with respiration; or it may even extend to the medulla, so as to involve the tongue and pharyngeal muscles, and more or less interfere with the functions of articulation and deglutition. In such cases death is liable to occur through asphyxia or slowly progressing exhaustion.

In the majority of cases of this disease, more or less complete recovery occurs, though it may be only after two to four years.

TREATMENT. — Possibly counter-irritation to the spine in the early stages by means of liniment of iodine may do good, and should certainly be tried, where the patient comes under treatment at this period. A nutritious and easily digestible diet, tonics (such as a combination of iron, strychnine, and arsenic), and rest are essential in the early stages, together with a thorough supervision of the general health. Later on, massage and electrical treatment by the voltaic current must be had recourse to, and must be perseveringly continued for long periods, until the muscles again begin to respond to the faradic current. The electrical treatment with massage is what is principally to be relied upon; and except in the subacute cases it may be commenced almost from the first, should the patient happen to come under observation during the early stage of the malady. Sulphur- or brine-baths seem also at times to do much good.

H. CHARLTON BASTIAN.

14. Progressive Muscular Atrophy.

See PROGRESSIVE MUSCULAR ATROPHY.

15. Locomotor Ataxy.

— *See* TABES DORSALIS.

16. Spinal Paralysis, Spasmodic.

—SYNON.: *Paralysis Spinalis Spastica*; Primary Sclerosis of the Lateral Columns; Idiopathic or Primary Lateral Sclerosis; Fr. *Tabes Dorsal Spasmodique* (Charcot); Ger. *Spastische Spinalparalysie*; *Primäre Sklerose der Seitenstränge des Rückenmarks*; *Primäre Lateralsklerose des Rückenmarks.*

This is one of the most recently recognised of the diseases of the spinal cord. It was described first by Erb in 1875, and within a few months of the same time in a thorough and independent manner by Charcot. Although these observers indicated with precision the probable pathology of the disease, they were not able to verify their anticipations by the examination of any patient who had died from (or whilst suffering from) this complaint. This last step was accomplished in this country by Dr. Dreschfeld.

But even before the disease was distinctly described, its probable existence and principal features were in part anticipated by Türck and by Charcot—both of them being guided more especially by the clinical effects associated with 'secondary degenerations' in the lateral columns of the cord, as they occur in conjunction with hemiplegia.

ÆTIOLOGY.—The disease is distinctly more common in males than in females. It occurs in the majority of cases in adults from twenty to fifty years of age. Erb and others have also described spasmodic forms of paralysis occurring in children, as a result of double cerebral disease, which have several clinical features in common with this affection. The writer has met with the ordinary form of the affection once in a child of about ten years of age, but then the lateral sclerosis seemed only to form a prominent part of what was really a 'multiple sclerosis' of cerebro-spinal type.

In some cases the disease appears independently of any appreciable predisposing or exciting causes; but, in other instances, falls or other traumatic influences, or great fatigue after some very prolonged walk, seem to be connected with its origin. On rare occasions exposure to wet and cold has appeared to have had some influence over the genesis of this, as well as over that of so many other forms of spinal disease.

ANATOMICAL CHARACTERS. — In the first undoubted case which was investigated *post mortem*, namely, that of Dr. Morgan, where the spinal cord was examined by Dr. Dreschfeld (*Brit. Med. Journ.*, Jan. 29, 1881, p. 152), the following pathological conditions were observed: 'The cord, when examined in the fresh state, showed to the naked eye no abnormality, except softening in the lowest dorsal region. After hardening in bichromate of ammonium, sections of the cord showed already to the naked eye one light-coloured patch in each lateral column'—and this throughout the cervical, the dorsal, and the lumbar regions of the cord. This band of morbid tissue, presenting all the typical characters of a sclerosis, occupied the greater portion of the lateral columns, but without implicating the grey matter or extending quite to the surface of the cord. The anterior and the posterior columns were perfectly healthy. The microscopical characters of primary sclerosis in the spinal cord are briefly described in the article on 'multiple sclerosis.' *See* 18. Multiple Sclerosis.

The occurrence of the slight softening in this case was an accidental complication, otherwise the lesions actually found agreed very perfectly with Charcot's scientific predictions as to the probable pathological changes peculiar to this affection of the spinal cord. Similar changes have subsequently been encountered in other cases.

Symptoms.—This disease often sets in almost imperceptibly, and the symptoms continue to develop in a very slow and gradual manner.

Patients begin to complain first of mere weakness of the lower extremities, and this continues to increase till a well-marked condition of paresis exists. There is great difficulty in getting upstairs, and the feet begin to drag even when the patient walks on level ground. This paresis may soon be associated with more or less of muscular twitchings, often more marked in the morning, but sometimes more especially at night, and of a painful character. Later, an actual stiffness of the muscles of the legs begins to manifest itself, which becomes apparent principally when passive movements are attempted, or even when the patient seeks himself to move the limbs. At last some amount of rigidity of muscles may be more or less continuously present, so as greatly to interfere with locomotion, or in some cases even to prevent it altogether.

In the early stages of the disease, ankle-clonus can be elicited with the greatest ease, and the knee-jerk is found to be distinctly exaggerated on both sides. When one of these patients is in the sitting posture, commencing pressure on the toes of one foot, as in the act of rising, will often at once initiate the characteristic tremors of ankle-clonus. All such signs, however, will probably diminish as the rigidity becomes more marked.

Whilst the patient is able to walk he often exhibits a typical 'spastic gait.' The legs are generally kept close together, owing to a spasmodic contraction of the adductors of the thighs; the toes are dragged along the ground; and then, when the heel is beginning to be brought down, in some rare cases a spasmodic contraction of the calf-muscles may take place, tending to raise the patient upon his toes and almost throw him forward. In this way a mixed and very irregular kind of walking is necessitated, partly to be accounted for by mere powerlessness, and partly by the occurrence of strong muscular spasms. In some instances, either owing to variations in the amount of the spasms, or, it may be, to the great weight of the patient, this spastic walk is not well-marked. In all cases, however, it is quite different from the ataxic gait; and when standing with feet close together, no increase of unsteadiness or feeling of vertigo is occasioned when the patient closes his eyes.

Sensibility is little, if at all, affected; still, in some instances it is apt to be slightly impaired. In one case, not long since under the writer's care, ability to recognise differences of temperature was for a time greatly lessened; and although tactile sensibility is scarcely at all interfered with, the patient has frequently complained of a diminished power in appreciating the exact positions of his legs. Skin-reflexes are often normal, but occasionally they may be slightly increased.

The muscles do not atrophy, and their electrical reactions continue to be almost normal; whilst, according to Erb, that of the nerves is slightly but distinctly lowered to both currents. Sexual desires are not affected, but sexual disability may be occasioned to a variable extent—partly owing to weakness or actual paralysis, and partly to mere spasms of muscles. Micturition is often scarcely at all interfered with; there is nothing like incontinence of urine or of fæces, though there may be an obstinate amount of constipation.

No vaso-motor or trophic disturbances in the limbs are usually present.

As the disease progresses (it may be very slowly, and in the course of years) the muscles of the trunk become affected, so that weakness and spasms, often of a very painful character, occur in the abdominal and dorsal muscles. After a time the arms also may become implicated, and in the same fashion as the legs, excepting that when permanent contractions of the muscles come on, they mostly fix the arm to the side, whilst the forearm is pronated and half-flexed, and the fingers and wrist are strongly flexed.

In rare cases the disease is limited to one side of the body, beginning, for instance, first in one leg, and then extending to the arm on the same side, so as to present a kind of hemiplegic distribution. Just as rarely, too, the disease may first affect the two upper extremities, and then extend down the trunk, so as ultimately to involve the lower extremities.

During the development of the disease, shivering fits, affecting the muscles of the jaws as well as almost all the muscles of the body, may occur from time to time, lasting for half an hour or more; and though quite unaccompanied by any changes of temperature, they may, nevertheless, be provoked by cold. Sometimes, however, such attacks occur spontaneously; or they may spread from some accidentally initiated ankle-clonus, or other well-marked spasm.

Persons suffering from this malady often remain in an almost stationary condition for a series of years, at any particular stage of the disease that may happen to have been attained. Ultimately, however, there is a tendency to complete paralysis of the parts affected, with permanent contractures—the legs at this stage being often immovably fixed in a condition of rigid extension, though they are sometimes flexed at hips and knees. As a rule, pains are not complained of at any stage of the disease, though some patients suffer much from painful cramp-like contractions, occurring either in the lower extremities, or else in some of the abdominal muscles.

Complications.—So long as the morbid process remains limited to the lateral columns, no other symptoms present themselves. Should it, however, invade the grey matter in particular regions of the cord, then characteristic complications are apt to arise, and it may also be said that the gravity of the disease becomes very distinctly increased. The way for a fatal termination may then be paved through the gradual increase, for instance, of bladder-troubles; or through the occurrence of severe bed-sores, and collateral events to which they may give rise.

Another possible extension of the sclerosis is to the posterior columns, so that we may get a variable mixture of the symptoms pertaining to 'spasmodic spinal paralysis,' and to 'locomotor ataxy.' It should be borne in mind, however, that such a complicated clinical grouping sometimes develops in the reverse order.

Usually in patients suffering from this disease, there is no association with cerebral symptoms, nor is there any tendency to the springing up of cerebral complications. Still, in one case under the writer's care a subacute maniacal condition became developed; whilst in another case diabetes mellitus to a slight but tractable extent has manifested itself. In both instances, however, there happens to have been a marked hereditary predisposition to the occurrence of insanity and of diabetes mellitus respectively.

Diagnosis.—The grouping of symptoms met with in this disease is so characteristic, that there ought in most cases to be no difficulty in recognising it. In no other organic affection of the spinal cord have we the combination of a gradually progressive paralysis beginning in the lower extremities, associated with muscular twitchings and rigidities; greatly exalted tendon-reflexes; no impairment of sensibility and no pains; no wasting of muscles or other trophic changes; and no interference with the functions of the bladder and rectum.

It happens, however, that certain functional diseases of the spinal cord, occurring principally in young women, may present nearly all these characters, and may for a time be excessively difficult of diagnosis from early stages of lateral sclerosis. In other of these functional cases there is an altogether unusual amount of sensory impairment of one or other kind occurring as additional symptoms, and in these the diagnosis is more easy. *See* 30. Functional Paralysis of Spinal Type.

Another difficulty arises in the recognition of the complex forms of the disease, or of combinations of this disease with others, then coming under observation for the first time. This, for instance, is the case where we have to do with a combination of posterior and lateral sclerosis, in which, in order to arrive at a diagnosis of the existing condition, the observer must be able to recognise the respective effects or modifications that may result from the combination of the two diseases. A further difficulty of the same kind arises when the symptoms of the disease are complicated by extension of the sclerosis to the grey anterior horns. Symptoms will then present themselves more or less resembling those which are described under the head of 17. Sclerosis, Amyotrophic Lateral.

Again, when 'multiple sclerosis' affects in the main the lateral columns, the real diagnosis can only be arrived at by the recognition of symptoms which could not be produced by a mere affection of the lateral columns. Thus the writer has recently had under his care a little girl, ten years of age, first brought to him on account of head-symptoms, which suggested the possibility of intracranial tumour, but in whom, after a few months, signs of lateral sclerosis have become developed in a very typical manner. She presented the most characteristic spastic gait, being frequently raised quite upon the points of her toes as she walked. There was also great exaggeration of the tendon reflexes, and no impairment of sensibility. The case seemed clearly one of 'multiple' or 'cerebro-spinal sclerosis.'

Prognosis.—So long as the disease-process remains limited to the lateral columns, as it does in the great majority of cases, 'spasmodic spinal paralysis' carries with it no danger to life. Such patients may survive for an indefinite time, even though for years after permanent contractures have become established they may have been absolutely confined to bed. Still Erb speaks of two cures, and of decided improvement in some other cases, and is inclined to think that this affection may prove a little more amenable to treatment than some of its congeners.

Treatment.—In the treatment of 'spasmodic spinal paralysis,' as in that of locomotor ataxy, we must use such means as are most likely to be of avail in checking the process of sclerosis in the columns of the cord which is the cause of the symptoms. The general health of the patient, and the regulation of his mode of life, must receive our most careful attention. Sound sleep must also be ensured, as far as possible.

Nitrate of silver has been praised by some; but the writer believes that, on the whole, more good is to be obtained from iodide of potassium in eight- or ten-grain doses, either with or without liquor arsenicalis. Small doses of cod-liver oil, either alone or in combination with maltine, also seem to do good. There is no particular indication for electrical treatment in this disease; but stimulation of the skin and subjacent parts, by frictions and massage, may be of service in the early stages, and so also may hot brine or sulphur baths. There are mostly no pains to be allayed; but occasionally painful cramp-like contractions of the muscles cause much distress to patients suffering from this disease. These pains are difficult to relieve, though good may be done, in some cases, by the extract of Calabar bean in increasing doses. For the rest, any accidental accompaniments of the malady must be treated upon the general principles applicable to the management of other spinal affections.

H. Charlton Bastian.

17. Sclerosis, Amyotrophic Lateral.

Synon.: Fr. *Sclérose Latérale Amyotrophique.*

This is a combination of symptoms first described by Charcot as a separate disease. Clinically, there is an admixture of the signs of progressive muscular atrophy with those of lateral sclerosis, whilst towards the close there is often the addition of a glosso-laryngeal paralysis. The affection is undoubtedly a rare one, and, after having stated the course of the disease as described by Charcot, we may consider how far this combination of symptoms is entitled to an independent place in our nosology.

Pathology, and Anatomical Characters. The peculiarity of this form of lateral sclerosis is said to lie principally in the fact that it commences in the cervical region, and soon spreads to the contiguous anterior horns of grey matter; thence, after more or less of an interval, it extends in two directions: (*a*) downwards, so as to involve the dorsal and lumbar lateral columns, and also the contiguous anterior cornua of grey matter; and (*b*) upwards, so as to implicate the upper cervical region of the cord and the medulla oblongata in a similar fashion.

Thus it will be seen that three peculiarities are asserted concerning this form of lateral sclerosis: (1) that it begins in the cervical region of the cord, and subsequently affects the dorsal and lumbar portions; (2) that it does not remain limited to the lateral columns, but soon spreads to the contiguous anterior cornua, where it leads to destruction of the great motor ganglion-cells; and (3) that it almost invariably extends upwards also, so as to involve the medulla oblongata, and thus to gradually bring about the death of the patient.

Symptoms, Course, and Terminations.—Being marked by the anatomical characters above described, it will be easily understood that patients suffering from this disease present an admixture of such signs and symptoms as may be met with separately in 'lateral sclerosis,' in 'progressive muscular atrophy,' and in 'bulbar paralysis.' We are said to have, in fact, the following grouping and sequence of symptoms:—

(1) Paresis, gradually increasing to actual paralysis of the upper extremities, and soon associated with distinct muscular atrophy and fibrillar twitchings. Any movements that can be executed are weak, and associated with tremors. More or less marked rigidity of muscles, and finally actual contractures occur, in which the arms are fixed close to the sides of the body; the forearms are semi-flexed and pronated, whilst the hands and fingers are strongly flexed.

(2) After an interval of some months, a similar group of symptoms becomes developed in the lower extremities. Again, we have paresis gradually increasing, with muscular tensions, exaggerated tendon-reflexes, and an increasing amount of rigidity of the lower limbs, which are usually fixed in the extended position. At a later period in the lower extremities, as compared with the arms, a process of muscular atrophy sets in, with development of the 'reaction of degeneration,' and fibrillar twitchings in the affected muscles.

During the whole of this time, there is little or no interference with sensibility. There is usually no implication of the sphincters, and no tendency to the formation of bed-sores.

(3) In the last stage of the disease, there is evidence of extension of the morbid process upwards to the upper cervical region and the medulla. Signs of bulbar paralysis present themselves in the usual way, by paralysis with atrophy of the tongue and lips, and by progressive weakening of the muscles of the palate, pharynx, and larynx. The phrenic nerve has also generally become involved,

and when weakness of the diaphragm is added to weakness or actual paralysis of the other muscles of respiration, this all-important function becomes more and more impaired, and thus a fatal termination may at any time be easily brought about. Increasing difficulty of articulation and deglutition may have existed for some months before death.

Many neurologists are now of opinion that no independent disease such as Charcot has described under this name of 'amyotrophic lateral sclerosis' exists. It is recognised by many to be only a mere variety of progressive muscular atrophy, and this view is in strict accordance with the writer's own experience. It must be admitted, in fact, that more or less of lateral sclerosis almost invariably co-exists in progressive muscular atrophy with the more distinctive degenerative changes in the ganglion cells of the anterior cornua; and in some cases it happens that the clinical signs of the former change are obvious, rather than much dwarfed or non-existent as they are in the large proportion of cases of progressive muscular atrophy. The writer is thoroughly in accord with Dr. Gowers when he says: 'It is probable that the pyramidal tracts are degenerated, if not constantly, at any rate in such a very large proportion of the cases of progressive muscular atrophy, that Charcot's distinction is in effect giving a new name to an old disease. Whether there are indications [clinical] of lateral sclerosis or not depends on the circumstance whether the degeneration of the pyramidal fibres is or is not more extensive than the complete degeneration of the nerve-cells that cause atonic atrophy. If the latter is universal, the pyramidal tracts may be totally degenerated, and yet there may be none of the characteristic indications of such degeneration. On the other hand, both arms and legs may be the seat of the spastic paralysis that indicates pyramidal degeneration, and atonic atrophy may be limited to a few muscles of the hands.'

The writer in his practice has found the atrophy of muscles either preceding or occurring simultaneously with the signs of spastic paralysis, and no regular division into stages such as has been described by Charcot. That bulbar symptoms occur in association with the other signs of progressive muscular atrophy is of course well known; and though their development may be often a late event, it is by no means always so.

The disease being, then, only a variety of progressive muscular atrophy in association with bulbar symptoms, nothing separate need be said concerning its DIAGNOSIS, PROGNOSIS, and TREATMENT, apart from what has been said concerning this disease. *See* PROGRESSIVE MUSCULAR ATROPHY.

H. CHARLTON BASTIAN.

18. Multiple Sclerosis of the Spinal Cord.

—SYNON.: Disseminated Sclerosis; Insular Sclerosis; Multilocular Sclerosis; Fr. *Sclérose en Plaques Disséminées*; Ger. *Multiple Sklerose des Rückenmarks*.

NATURE AND ÆTIOLOGY.—Nothing approaching to an adequate recognition of the characters and importance of this disease was made anterior to the year 1866. Then, and in the two or three subsequent years, the malady may be said to have been identified and characterised by Vulpian and Charcot, but more especially by the latter and his pupils.

It is a disease produced by the development of patches of sclerosis of varying size and shape throughout the spinal cord, and most frequently also in different parts of the brain. Clinically the disease is met with under the most diverse forms, according to the different sites and sizes of the patches of sclerosis occurring in different cases. These different forms of the disease are divisible into three partially distinct types, according as the morbid changes and symptoms occur in and are referable: (1) to the spinal cord alone (*spinal type*); (2) to the cerebrum alone (*cerebral type*); or (3) to the brain and spinal cord (*cerebro-spinal type*). As the dominant symptoms of the disease are often those of the spinal type, even where there is also an extension of the morbid process to the cerebrum, it will be most convenient to speak here in the main of the 'cerebro-spinal' type. It is, moreover, both more frequent and a more characteristic malady than either of the simpler forms.

In regard to the ætiology of the disease little can be said. It may occur with or without the predisposing influence of a neurotic tendency. It is at least as common in females as it is in males; and though rarely occurring in children under ten years of age, it is perhaps most common between the ages of ten and thirty years. Beyond the age of forty it again becomes very rare.

Amongst the exciting causes, exposure to wet and cold would seem to take the first rank. After this come traumatic influences of various kinds, mental shocks or troubles, great fatigues from mental or bodily labour, and finally the state of convalescence from several acute diseases, such as typhus, cholera, variola, or other specific fevers. The disease has been said to occur sometimes as a sequence to severe and long-continued hysteria; but in some of such cases at least it would seem to be far more probable that the early and obscure symptoms connected with this affection were those which were regarded as hysterical. 'Hysteria' may be produced or simulated in many ways, but as itself a producer of organic changes its *rôle* is assuredly open to grave doubts.

ANATOMICAL CHARACTERS.—The patches of sclerosis which constitute the anatomical basis of this disease do not differ in their essential nature or in their appearance (macroscopic or microscopic) from the similar overgrowths of the neuroglia that occur in locomotor ataxy and in primary lateral sclerosis.

On the cut surface of the spinal cord, medulla, or other portion of brain, the foci of sclerosis mostly reveal themselves as greyish, greyish-red, or semi-gelatinous yellowish patches, differing principally by reason of slight contrasts in colour, from the dead white of the more healthy columns of the cord, and from the natural appearance of the grey matter. The tissue of the patches may either be level with, project slightly above, or sink slightly beneath, the general cut surface of the cord. The same differences also exist in regard to those patches which involve the external surface of the cord—they may at times, when the new tissue is excessive, rise slightly above the surface; whilst later on, when shrinking has occurred in the cirrhotic patch, some amount of superficial depression may be met with.

The patches vary much in size; in the spinal cord they range from a mere pin's head to that of a large pea, or of a bean; whilst in the cerebrum or in the cerebellum they may attain still larger dimensions. In the spinal cord the patches occur in all parts of its longitudinal extent, and they may occupy very variable portions of the transverse area of the cord. Some involve principally the lateral, others the anterior or the posterior columns of the cord; or portions of the grey matter, either alone or in conjunction with one or more of these columns, may be implicated for a variable extent, transversely and longitudinally. Patches of different sizes, and varying in their transverse extent, occupy different levels of the cord, and may thus occur in an irregular series throughout the organ.

These spinal foci of sclerosis, again, may be associated with patches of the same kind distributed through the medulla, pons, and cerebral peduncles, in part superficially and in part within their substance. Similar patches may be found in variable number, and quite irregularly distributed, through other parts of the cerebrum, as well as through the cerebellum.

In regard to the *microscopical characters* of these foci of sclerosis, certain differences are met with in different cases, principally dependent upon the age, or stage of formation, of the patches. Without going into minute details, it may be said that there is in all cases a hyperplasic overgrowth of the neuroglia which naturally exists around and between the nerve-elements. The nature of this change becomes quite distinct when properly prepared sections of the cord have been tinted. The new tissue takes the staining fluid freely, and when the circumference of a patch (especially some small one) is examined, it becomes obvious that numerous thickened processes of neuroglia connect it with the healthy tissue around. It is by the hypertrophy and gradual fusion of these circumferential prolongations that the morbid growth progressively encroaches upon the previously healthy portions of the cord. As this mere intermediate tissue grows, it presses upon and constricts the nerve-fibres and nerve-cells, so as to cause atrophy of the latter and a partial atrophy of the former. For there is reason to believe that the nerve-fibres do not wholly disappear; in these patches of primary sclerosis (as in the case of 'secondary degenerations') it is the white substance of Schwann which disappears, whilst the axis-cylinders, or a considerable number of them, persist. In the new tissue itself we find the usual granular or very finely fibrillar matrix, containing minute spherical or ovoidal plastides, also branched cells, and occasionally a few granulation-corpuscles. The latter are met with especially during the earlier stages of a patch of sclerosis; just as corpora amylacea or colloid bodies may be found in older patches. The walls of the capillaries as well as of arteries and veins are generally greatly thickened, and the vessels in a patch of this kind may be both numerous and large; in other cases, however, the number of vessels existing in the patch is by no means so conspicuous. It is well known that the adventitia or outer coat of the vessels in these patches is specially apt to become thickened, and that this sort of overgrowth may extend inwards, so as to cause fibroid degeneration of the middle coat and even of the intima. It is probable that proliferation also takes place from the inner surface of the intima (an endarteritis), and that occasionally, owing to this cause, a thrombosis may be brought about. Certain it is that the writer has on several occasions found the larger vessels of a patch of spinal sclerosis blocked by an old and firm thrombus.

PATHOGENESIS.—With reference to the starting-point of a patch of sclerosis nothing definite can be said. Not infrequently disseminated sclerosis may be met with in the absence of any cachexia, syphilitic or other; and, moreover, patches of sclerosis may occur in the nervous system only, or to no notable extent in other organs of the body. This, therefore, would indicate the existence of something, or of some process, of an abnormal kind taking place in the spinal cord and brain, and again not uniformly through them, but in foci situated here and there. It is no explanation, as some seem content to suppose, merely to say that the abnormal processes are 'chronic inflammations'; since, whether it is or is not advisable to speak of the changes by this name, we should still have to ask what is the cause of such local departures from healthy nutrition. Does the process begin in the connective-tissue elements themselves? or is there some primary change in the small vessels (possibly of the nature of endarteritis) leading to obstructions and a sequential overgrowth of the neuroglia? It would seem pretty certain, at all events, that the change in the nerve-elements proper follows the overgrowth of the neuroglia—as certain, indeed, as that throughout a band of 'secondary degeneration' the order of these changes is exactly reversed. There fatty degeneration and atrophy of the nerve-fibres are the first events, and these are followed by hyperplasia of the neuroglia. *See* Spinal Cord, Diseases of: § 5, (13).

One of the most interesting facts, in connexion with these patches of primary sclerosis, is to be found in the circumstance that they themselves rarely lead to bands of descending 'secondary degeneration' in the anterior or lateral columns, or of ascending degeneration in the posterior or lateral columns. The fact itself has been long observed, and always regarded as rather surprising. The writer believes it to be explicable by the fact previously mentioned, that the bulk of the axis-fibres remain, so that the nerve-fibres below the seat of lesion (or above in the case of the posterior and parts of the lateral columns) are not absolutely cut off from the nerve-cells which exercise a 'trophic' influence over them. Some nerve-tremors may still pass along the damaged fibres in the sclerotic patch,[1] and thus the nerves in the parts beyond do not degenerate, as they would do if the fibres had been absolutely cut across. Some fibres may be completely strangled and then absorbed, and in such a case the continuations of these nerve-fibres would degenerate. In the final stages of a sclerotic patch this kind of sequence is apt to occur; so that towards the end there may be the tendency to the occurrence of some amount of secondary degeneration, even though the degenerated fibres may not constitute a very compact band.

Symptoms.—It can easily be understood, from what has already been said, how much the symptomatology of this disease is liable to vary in different cases, according to the varying situation, extent, and order of evolution of the morbid patches. That it is possible to assign anything like a definite symptomatology for this affection, is due to the fact that there are certain seats of election in which the patches of sclerosis are specially apt to occur. The sites affected with special frequency are the lateral columns of the cord, the medulla, and the pons; and it is with the occurrence of patches of sclerosis in these situations that we have the following set of correlated symptoms pertaining to the 'cerebro-spinal' type of the disease.

A slowly ensuing paresis of the lower extremities begins first in one limb, and then after a time involves the other. During this time the paresis develops into a more and more marked paralysis, though the sensibility of the limbs remains almost completely unaffected—nothing more than a temporary numbness being complained of in the majority of cases, whilst lightning-like pains and girdle-sensations are altogether absent. After an interval, first one and then another upper extremity may become weak and subsequently more or less paralysed. During these early stages of the disease more or less distinct remissions of symptoms may occur from time to time.

Meanwhile a most typical sign soon shows itself in the paretic or semi-paralysed limbs, in the form of a marked trembling or shaking of those muscles or parts of a limb which are called into voluntary action with any intensity, although these phenomena immediately subside when the voluntary exertion ceases. The involuntary movements consist either of extremely well-marked tremors, like those met with in some cases of paralysis agitans, or else of movements of greater range, more resembling those of chorea.

Later some paresis of the trunk-muscles may occur, as well as of those of the neck; and this may be followed by a similar affection of the tongue, lips, and facial muscles—possibly, also, of those of the palate, pharynx, and larynx. When a patient affected in this manner, who has been previously lying perfectly still in bed, is told to endeavour to sit up, shakings and tremors begin in almost all parts of the body, and the scene is strangely changed until all voluntary efforts cease, and the recumbent position is again assumed. The same kind of thing is seen when movements of particular parts of the body are attempted: thus when, in the sitting posture, the patient attempts to hold up one leg, tremors of it immediately begin; ask him to take hold of something or to squeeze a dynamometer, and the upper extremity called into action at once begins to shake; request him to put out his tongue, and immediately irregular protrusions of the organ occur, associated with twitchings about the angles of the mouth and even in other parts of the body. The act of walking may cause, in more or less advanced cases, tremors of the legs, arms, trunk, head, and neck—all at the same time.

Movements of slight intensity occasion either no shakings or merely tremors of a very fine kind. The latter are seen in the early stages of the disease when writing is attempted. Almost each letter registers a number of fine tremors, mixed here and there with greater irregularities. In more advanced cases, however, the movements are so disorderly that writing becomes either impossible or wholly illegible.

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[1] In support of this, there is the fact mentioned by Charcot, that an optic nerve which was affected through its whole thickness by sclerosis was yet capable of performing its functions.

Just as there is no loss of ordinary sensibility, so we find that patients often remain fully conscious as to the positions and movements of their limbs, and that closure of the eyes causes no increased uncertainty of their movements unless the posterior columns be distinctly affected; and, except under these latter conditions, when in the standing position, they are not rendered more giddy or more unsteady by closure of the eyes.

Up to this stage there may be no distinct interference with the functions of the bladder or the rectum. The tendon-reflexes are, however, generally distinctly exaggerated: ankle-clonus may be obtained with readiness, and the knee-jerk is often more pronounced than usual. There is no tendency to the formation of bed-sores; no wasting of muscles; nor is any alteration in their electrical excitability met with.

After variable and often long periods, the affected lower extremities, which have become more and more paralysed, may in some cases show signs of commencing bar-like rigidity. The limbs, as the patient lies in bed, are closely drawn together, and in a condition of rigid extension, which is generally increased when any attempts to move them are made. At first this condition of the limbs ensues from time to time, in the form of paroxysms lasting for an hour or two. But, later, the attacks become both more frequent and longer, so that ultimately the condition of rigidity becomes permanent. Contractions of the arms are less common, and when they occur they become fixed at times in a different position from that met with in simple lateral sclerosis (*see* 16. Spasmodic Spinal Paralysis); that is, like the lower extremities, in a condition of extension, and closely drawn to the sides of the body. At this period ankle-clonus can often be elicited with the greatest ease, and the movements set up in the one leg may extend to the opposite lower extremity, and may indeed lead to more or less of general tremor throughout the body. Exposure to cold, or irritation of the skin in various ways, will also often suffice to initiate this general tremor, which, as Brown-Séquard showed, may commonly be caused to cease instantly by a forcible flexion of one of the great toes. With the cessation of the tremors consequent upon this manœuvre, the limbs may also be left for a time in a supple and flaccid condition.

The manifestation of tremors of the tongue, lips, and face is of course a sign that the bulb is affected; and when this occurs, simultaneously or very soon after, other evidences of implication of the bulb and of contiguous portions of the cerebrum may be met with. Articulation may become more or less affected, the speech being rendered slow, hesitating, and measured, syllable by syllable; or it may be jerky in character—becoming especially thick and blurred in the later stages of the disease. The power of swallowing is less frequently impaired, but in advanced stages it is apt to be affected.

Nystagmus is almost invariably met with. Diplopia, or actual paralysis of the ocular muscles, is rare. Amblyopia not infrequently exists; perhaps in one eye only. Actual blindness is very rare.

Vertigo, sometimes to a marked extent, is no uncommon symptom; and as the cerebrum becomes more and more affected, a condition of well-marked hebetude, or actual dementia, gradually becomes pronounced. This betrays itself externally by a blank, expressionless aspect of the face; the patient becomes childish in manner, his memory fails, and he takes interest only in trifles; he may also laugh constantly without adequate cause, or, on the other hand, is very easily moved to tears.

During this condition of things a subacute maniacal condition may supervene; or the patient may develop 'delusions of grandeur' precisely similar to those met with in general paralysis of the insane—examples of which the writer has recently seen in two of his own patients. In other cases persons suffering from this disease may lapse into a profoundly melancholic condition.

At this stage, too, apoplectiform or epileptiform attacks are particularly apt to occur from time to time. After such attacks, of whichever kind, the limbs on one side of the body and the face are left more or less paralysed; and where the attack has been epileptiform in character, the convulsive twitchings are often limited to this one side of the body. As Charcot has pointed out, these attacks are precisely similar to those which occur in general paralytics, or in cases of old hemiplegia with descending sclerosis. They answer to the so-called 'congestive attacks,' but they do not seem to be associated with any new appreciable lesions of a 'gross' order. Such epileptiform attacks may be brief, or they may last for hours; or, off and on, even for days. In all of them the temperature begins to rise almost at once—without any initial period of depression—and may even reach 104° in a few hours, or in a day or two. The temperature then begins to fall again; or, should it continue to rise to a still higher point, the attack is very apt to terminate fatally.

Every attack of this kind leaves the patient in a manifestly worse condition, both bodily and mentally; and perhaps in one of them at last death may occur.

Varieties.—The symptomatology of this disease is likely to be considerably modified in different cases, but principally in two directions, productive of complications of the same kind as those which are also apt to occur in 'spasmodic spinal paralysis.' In each disease there may in some cases be a special affection of the posterior columns, in one or other region of the cord, bringing with it more interference with sensibility, and an admixture of other symptoms pertaining to locomotor ataxy. These are some of the cases which have been described under the separate name of 'ataxic paraplegia' (*see* PARAPLEGIA, ATAXIC). It is, perhaps, principally in these cases that the '*crises gastriques*' (pains, vomiting, and occasionally diarrhœa) are also met with. In other instances there may be an extension of the sclerosis to the grey matter of the anterior cornua in one or other region (as well as to other parts of the grey matter), leading, amongst other phenomena, to muscular atrophy in related regions of the body. In either of these ways the symptoms of the original disease may be complicated, and, to a certain extent, obscured.

Many other differences also present themselves in special cases, owing to the varying situations in which the morbid patches make their first appearance. In a distinct minority of the cases the disease seems to reveal itself first in the brain rather than in the spinal cord.

TERMINATIONS.—After this disease has pursued a very slow course for years (often five to ten), the miserable sufferers from it may at last be carried off in various ways. Death may take place in one of the apoplectiform or epileptiform attacks, occurring either in patients who are merely slightly demented, or in those who are otherwise actually insane; or, at last, in cases in which there is great interference not only with articulation but also with deglutition, the functions of the heart or of respiration may also become affected, and this disturbance may lead on to a fatal termination.

In other cases, after the disease has lasted for years, and when the grey matter of the cord has become seriously involved, accidents may supervene similar to those which occur in the final stages of many cases of paraplegia. The bladder may become paralysed, and after a time inflammation and ulceration may be set up, followed by secondary inflammation of the ureters or kidneys. Or bedsores may form, sloughing may go on extensively, and the patient may at last die exhausted, or from the supervention of blood-poisoning. At other times the patient is cut off by some acute inflammatory disease.

DIAGNOSIS.—In its early stages the diagnosis of this disease may present very considerable difficulties. This is especially the case when the morbid process begins in the cerebrum. Here for a time there may be nothing distinctive, and we have to wait for the further development of the disease before anything like a positive diagnosis is possible. Similarly, where the disease begins only with spinal symptoms, it is often extremely difficult to diagnose it with certainty in its very early stages. The important characters in the more typical forms of the disease are the youth of the patient, the paresis gradually increasing, first in one and then in the other lower extremity, with no alteration in sensibility or in the electrical irritability of the nerves or muscles, but with ankle-clonus and exaggerated knee-jerks. Still it must be borne in mind that all these signs may be met with in the spastic forms of Functional Paralysis of Spinal Type (*see* 30); and, especially when they occur in young women, the diagnosis is often beset with the greatest difficulties. Even the most experienced observer may remain for a time in doubt as to whether he has to do with the beginnings of organic disease, or with mere functional derangements of the spinal cord. But when the peculiar tremors and disordered movements on voluntary excitation of the muscles are met with, together with the absence of any such tremors in the condition of rest, and some amount of paresis or of similar symptoms in one or both upper extremities, the diagnosis of the 'spinal' type of this disease can be no longer difficult or doubtful.

By far the most typical cases, however, are those of the 'cerebro-spinal' type, in which, with such symptoms as are above indicated, there are also some others due to disease of the medulla, pons, or adjacent parts, such as tremors about the lips and tongue, altered speech, and nystagmus. In these cases the disease is really quite distinctive; so that the malady ought to be easily recognised when the patient is seen at this stage for the first time. Chorea is the affection with which such a stage of the disease is most apt to be confounded; but the absolute cessation of all tremors and disordered movements in multiple sclerosis when the patient is at rest, and their immediate re-initiation (mainly in the parts moved, but also often to some extent in others) on the occurrence of voluntary efforts, is a thoroughly distinctive characteristic.

Paralysis agitans ought to be distinguished from disseminated sclerosis with even more ease. It is scarcely ever met with in persons under the age of thirty-five, whilst multiple sclerosis does not very often begin in persons beyond such an age. The movements of paralysis agitans, again, are only to a slight extent exaggerated by voluntary exertion of the parts, whilst sometimes they are actually lessened thereby; and such movements, in the form of fine tremors, do not cease to anything like the same extent under conditions of rest. Again, there is generally no shaking of the head and neck in paralysis agitans.

Mercurial poisoning with tremors can be easily distinguished, on inquiry into the history of the patient, and the mode of onset of the disease.

In those more irregular cases of multiple sclerosis, in which there is either an unusual amount of implication of the posterior columns of the cord, or of the grey matter in some region or regions, the diagnosis of the complex nature of the affection must be based upon the general principles applicable to the regional diagnosis of spinal cord disease.

PROGNOSIS.—Absolute cure of this disease is scarcely to be hoped for. The most that has been done, hitherto, as a result of treatment, has been to help to bring about more or less distinct remissions, and also to delay the progress of the disease. Death usually occurs in from five to ten years, in one or other of the modes already indicated.

TREATMENT.—Many drugs have been tried, but hitherto with little or no positive result, in the treatment of this affection. Nitrate of silver has seemed to do good in some cases, especially in the early stages. But the writer is much more disposed to trust to iodide of potassium in eight- or ten-grain doses three times a day, with or without moderate doses of liquor arsenicalis, or of perchloride of mercury; combining the use of those drugs with cod-liver oil, alone or with maltine, and a good nourishing diet. From time to time, however, the above medicines should be omitted, and simple tonics taken in their place. In the early stages of the disease, hot brine or sulphur baths and massage of the limbs may be of service; and in all cases it is of great importance to see that the patient obtains sound sleep, since in this, as in all other chronic spinal diseases, the patient's downward course is likely to be hastened where an adequate amount of sleep is not obtained.

No distinct indications exist for the treatment of this affection by electricity, and no advantages have as yet been recorded from its use. The complications of the disease, which may occur in its later phases, must be treated in accordance with the general principles applicable for this as well as for other spinal affections. Every effort must be made to preserve the general health of the patient, as this will probably be found to be the surest means of holding in check the progress of the disease.

H. CHARLTON BASTIAN.

19. Friedreich's Disease.

SYNON.: Hereditary Ataxy; Postero-lateral Sclerosis of the Spinal Cord; Diffuse Sclerosis of the Spinal Cord and Bulb.

This is a disease apt to show itself in several members of the same family, at periods varying mostly between early childhood and the twenty-fifth year. It has been found to be two or three times more frequent in males than in females. It is not an hereditary disease in the strict sense of the term; it is rather a 'family disease,' showing itself in several children of the same parents, although neither they nor their parents may have had the disease. The term 'hereditary ataxy' is therefore misleading.

NATURE AND PATHOLOGY.—When first recognised, this disease was regarded as a form of locomotor ataxy; but, as Charcot and Bourneville have pointed out, some of the cases at least are much more closely related to 'disseminated sclerosis.' Friedreich's disease is, in fact, a malady as it were intermediate between these two affections, having important alliances with each, though, for the most part, the alliance is closer between it and disseminated sclerosis than between it and locomotor ataxy.

The disease is dependent upon the development of areas of sclerosis in the posterior and in the antero-lateral columns of the cord, as well as in some parts of the grey matter; together with an extension of such morbid processes to the bulb, so as to implicate the hypoglossal nuclei and other parts. The disease has, therefore, likewise been named 'Diffuse sclerosis of the spinal cord and bulb.'

SYMPTOMS AND COURSE.—Generally commencing without any special exciting cause, and mostly during adolescence, the malady shows itself first by the occurrence of a gradually progressive weakness in one or both lower extremities, together with an unsteady or uncertain, rather than a distinctly ataxic gait. The legs are often placed wide apart, and the walk is not unlike that of a drunken man. By slow degrees the weakness increases, till even standing becomes impossible. The weakness and uncertainty soon extend to the upper extremities, which also become tremulous during the execution of movements. Most frequently this incoördination is not exaggerated by closure of the eyes.

Later on the trunk and the head become the seat of oscillations, which are exaggerated when the patient executes any movement, but, on the other hand, cease when he is completely at rest in the recumbent position.

In males a condition of impotence supervenes; and in females the menstruation becomes exceedingly irregular. These signs are not long in showing themselves when we have to do with patients past the age of puberty.

After some years the tongue partakes in the trembling, and speech becomes hesitating, thick, and at last scarcely intelligible. Ultimately the tongue may become completely paralysed and motionless.

Nystagmus of a slow horizontal character is apt to show itself, on the occasion of voluntary movements of the eyeballs.

During the final stages of the disease there is often more or less complete paralysis of all the limbs—sometimes associated with muscular atrophy. At this period, also, the limbs are occasionally affected with cramps, or transitory contractures.

Again, it is only during the final stages of the disease that affections of sensibility are prone to show themselves—and that, principally, in the form of anæsthesia of the lower extremities, often so complete as to involve the joints and muscles as well as the skin. Sometimes pains are complained of, but they are rather erratic in character than of the lightning-like or lancinating type.

The special senses and the intellect usually remain intact. The pupil often remains sensitive to light, and may be even rather unnaturally sensitive.

The sphincters are not affected; and there is no tendency for bed-sores to occur.

Sudden attacks of vertigo are apt to supervene (and that quite irrespective of the position of the patient at the time); or towards the close of the disease actual apoplectiform attacks may occur, in one of which the patient may succumb. Such an attack is said to be of the following type: 'It is characterised by a rapid but incomplete loss of consciousness, by resolution of all the limbs and a generalised anæsthesia, by a considerably impeded respiration which is of a jerking and noisy type, by a tumultuous action of the heart and great frequency of pulse (130), together with a notable elevation of temperature' (Brousse).

The progress of the disease is often extremely slow, but always fatally progressive. It may last from five to thirty years.

Diagnosis. — As already indicated, the diagnosis has to be made principally between Friedreich's disease and disseminated sclerosis, or else between it and locomotor ataxy. Such difficulties of diagnosis must, however, present themselves principally in regard to the first case of Friedreich's disease that happens to show itself in a family. If the medical attendant is aware that already one or more of the patient's brothers and sisters have become affected in a similar manner, more than half the difficulty of diagnosis is at once got rid of—supposing the practitioner to be aware of the existence and general nature of such a malady as Friedreich's disease. This is so, because several cases of ordinary locomotor ataxy or of insular sclerosis in the same family must be regarded as events of extreme rarity.

It should, however, be borne in mind that in Friedreich's disease (as well as in locomotor ataxy, and disseminated sclerosis) much variation exists in different cases, in the rapidity and in the order of development of the several signs and symptoms. A similar variability exists in regard to the relative development of these several signs in different cases—the result being that only a generic similarity is likely to exist between any two or three consecutive cases of this disease that may chance to present themselves to the same observer.

Supposing, however, that we have to do with a solitary case of disease, then the question of age becomes of first importance. If the patient should be under twenty years of age, the chances would be decidedly against locomotor ataxy, and in favour of the case being either one of Friedreich's disease or of disseminated sclerosis; while the indications would be still further against locomotor ataxy, if there should be an absence of the peculiar pains characterising this latter disease, or of other affections of sensibility.

The points, in detail, which must be taken into consideration for the diagnosis of these three diseases from one another are given below in parallel columns.

Locomotor Ataxy.	Friedreich's Disease.	Disseminated Sclerosis.
Rarely before twentieth year.	Commonly before twentieth year.	Often before twentieth year.
Affections of sensibility early and constant. Sight and hearing often affected.	Affections of sensibility absent.	Affections of sensibility generally absent, though sight and hearing are sometimes affected.
Double vision, and Argyll-Robertson pupil present.	Double vision, and Argyll-Robertson pupil absent.	Double vision frequent, and Argyll-Robertson pupil absent.
No nystagmus.	Nystagmus frequent.	Nystagmus very common.
No oscillations of head and trunk.	Oscillations of head and trunk very common.	Oscillations of head and trunk frequent.
Knee-jerk absent; no ankle-clonus. No rigidities.	Knee-jerk either absent, of medium intensity, or exaggerated. Sometimes clonus. No rigidities.	Knee-jerk commonly exaggerated, and clonus present. Rigidities common.
No speech defects.	Difficulties in speech.	Difficulties in speech.
Simple incoördination in arms common.	Tremors of arms exaggerated by movement.	Tremors of arms, on movement, gradually becoming choreic in range.
Mental disturbance rare.	No mental disturbance.	Mental disturbance frequent.

Prognosis and Treatment.—The disease is not amenable to any special line of treatment. On the other hand, it is one which is comparatively little dangerous to life. Patients so affected may live for prolonged periods, if due care be taken to maintain their general health.

H. Charlton Bastian.

20. **Spinal Cord, Tumours of.**—Synon.: Intra-medullary Tumours; Fr. *Tumeurs de la Moelle*; *Tumeurs Rachidiennes*; Ger. *Krankhaften Geschwülste des Rückenmarks.*

Ætiology and Anatomical Characters.—Tumours originating in the substance of the spinal cord may be regarded as belonging to two classes, according as they represent (*a*) mere *local* accidents in the form of perverted tissue-changes; or (*b*) such local accidents developing under the influence of a distinct *general state*, such as syphilis or scrofulosis.

(*a*) Of the purely *local* overgrowths, the most typical, and perhaps also the most frequently occurring, are *gliomata*. The consideration of these growths comes in natural sequence to that of *sclerosis* affecting different regions of the cord. In such a tumour we have an exuberant overgrowth, as Virchow and most other pathologists suppose, starting from the neuroglia of a certain portion of the cord. At first the growth infiltrates and substitutes itself in the place of a certain amount of nerve-tissue; but it soon grows excessive in quantity (spreading in area perhaps at the same time), and thus comes to exercise a more and more marked compression upon the remaining tracts of nerve-tissue composing the cord at the same level, within the narrow and unyielding boundaries of the spinal canal. In extreme cases a spinal cord may, as the writer has seen, become so infiltrated with new-growth throughout the greater part of the cervical and dorsal regions, that it attains almost twice its natural bulk. These gliomata are oftentimes extremely vascular. They are liable to undergo a certain amount of central softening; and into their substance, especially in the softened foci, hæmorrhages are very apt to occur. Softening of nerve-tissue may also, at a certain stage, take place around a more circumscribed growth, and thence may extend for a variable distance above and below.

Other tumours of an allied nature, such as *sarcomata* and *myxomata*, also at times develop, either in their pure types or with blended characters, within the spinal cord. They present few intrinsic peculiarities in their manner of affecting the cord. They rarely attain any large size; indeed the limitations of the spinal canal only permit of much increase in one direction. And elongated growths are occasionally met with. To a considerable extent, such tumours have an infiltrating mode of growth, though their boundaries are apt to be rather more defined than are those of gliomata.

In regard to the causes of these tumours, almost nothing more definite can be said than that they seem, at times, to find occasion and conditions suitable for their initiation after some blow upon the spine or concussion of the spinal cord.

(*b*) Of the growths which tend to occur in the spinal cord (as occasionally in other parts of the body) under the influence of some *general* disease or diathetic condition, two are especially to be named. These are *tubercular growths* and *syphilitic gummata.* The former are generally small, varying in size from a mustard-seed to a pea, and only very rarely attaining the dimensions of a hazel-nut. Next to gliomata, they are the new-growths most frequently met with in the substance of the spinal cord. When small, they may occur in association with a cerebro-spinal tubercular meningitis; but at other times they are found, and especially the larger growths, existing independently of any acute inflammation of the meninges. In this latter case, the tumours may be combined with a certain amount of adjacent and secondary softening of the substance of the cord.

Syphilitic gummata, originating in the cord itself, occur only with the greatest rarity. They are more frequently found starting from the meninges, and then they may press upon or actually grow into the nerve-substance.

Cancer is believed not to occur primarily in the substance of the spinal cord, though it may grow into its substance, or seriously press upon it, when originating either in the meninges or in the vertebræ.

Symptoms, Course, and Terminations.—The difficulties of diagnosis are almost always very great in the case of tumours of the spinal cord, because in their early stages, and occasionally for prolonged periods, they are associated with slight and somewhat vague symptoms.

Independently of the variations in different cases, consequent upon the longitudinal situation or level of the tumour in the spinal cord, the symptoms to which they give rise in various parts of the body may be more or less vague anomalies of sensibility in different regions, associated with a certain amount of weakness, often not amounting to actual paralysis.

Growths from the meninges, or from the vertebræ, pressing upon the spinal cord, are not quite so apt to run a latent course for any length of time, since they are rather more prone to involve the anterior or the posterior roots on one or on both sides—at first irritating them, and subsequently causing paralysis from pressure. Thus localised numbness, pains, or anæsthesia, either alone or associated with twitchings, cramps, or paralysis, confined to certain parts of the body, are rather more common incidents during the growth of extra- than of intra-medullary tumours. Still the diagnosis between these two classes of tumours may be impossible.

Sclerosis, in its 'insular' form, especially when the patches are few or close together, may also present symptoms almost inseparable from the first stage of some intra-medullary tumour. The important fact is, however, that sclerosis in the cord tends to become more and more generalised, and thus gives rise to a proportionately widening range of symptoms; or else it limits itself to special columns, and thus becomes associated with more special sets of symptoms.

With any of these tumours of the spinal cord, the symptoms are, after a time, liable to undergo a sudden and grave increase, owing to the occurrence of a hæmorrhage into its substance and perhaps into adjacent regions of the spinal cord, or else owing to the commencement of a process of secondary transverse softening. Beyond these possibilities of sudden grave augmentation of symptoms, the course of intra-medullary tumours is also apt to be marked by peculiar exacerbations and remissions from time to time, in association with periods of altered growth or vascularity of the tumour itself.

Diagnosis.—The very gradual onset of the symptoms in cases of tumour of the spinal cord is a point of great importance in the diagnosis of these conditions. Thus, for instance, we eliminate arachnoid or intra-medullary hæmorrhages, and also the numerous class of cases of softening of the spinal cord, with other affections having a more or less abrupt origin. The diagnosis of tumour of the cord as distinct from its compression by disease of vertebræ (where there is also generally a slow evolution of paralytic symptoms) must be based in part upon the absence of distinct pains and of any evidence of vertebral disease. The diagnosis from meningeal tumours has already been referred to under the head of Symptoms; and so also has the diagnosis from mere sclerosis of the spinal cord, in which the connective-tissue overgrowth is not sufficiently bulky to amount to an actual tumour.

If the arrival at a diagnosis as to the existence of a tumour of the spinal cord is a process beset with difficulties, these by no means cease when, passing from the primary, we have to approach the secondary question as to the *nature* of the growth presumed to exist. But little is possible in this direction. It is true that, with a history of pre-existing syphilis, even without the evidence of other simultaneous manifestations, we should be warranted in assuming it to be even more than possible that an existing growth was syphilitic in nature, and in treating the patient accordingly; and that all the more because this is about the only kind of new-growth as to which we have distinct evidence of its amenability to the influence of remedies. The presumptions in favour of the tubercular or scrofulous nature of a supposed new-growth in the spinal cord would rarely carry with them more than a moderate amount of cogency. Still, occasionally the general habit of the patient, together with the fact of the existence of scrofulous enlargement of glands, or of some forms of phthisis, might give more or less probability to such a conclusion. Beyond this, not much can be done in the way of diagnosing special kinds of tumours. We might be guided in our opinion as to the possible existence of a sarcoma by the presence of one or more of such growths in other parts of the body; or, failing this, we may recollect that primary cancer affecting the spinal cord is almost unknown, and that gliomatous tumours are, next to the tubercular or scrofulous, those which are most frequently met with in the cord itself.

Prognosis.—The prognosis in all these cases is bad. Life, it is true, may last for months or even years, but the tendency is for the primary affection to set up other secondary accidents, in the form either of hæmorrhage or of softening. Thus, paralysis is rendered more complete, and the way is paved for an ultimate fatal termination, through the intervention of cystitis and renal mischief; by way of bed-sores with exhaustion and blood-poisoning; or by extension of softening upwards to the cervical region, and the supervention of respiratory paralysis.

Treatment.—In the case of the existence of a syphilitic tumour in the spinal cord, we may attempt (and with some expectation of success) to treat the causal morbid condition with large doses of iodide of potassium (gr. xv.–xxx.) in combination with perchloride of mercury. But in almost all other cases little can be done in this direction, and we are reduced to the necessity of dealing with the paraplegic state and its attendant conditions as best we can, and also of attending to the general health, with the view of arresting the progress of the disease and keeping its possible complications in check. *See* 9. Spinal Cord, Softening of.

H. Charlton Bastian.

21. Syringomyelia.—Synon.: Syringomyelitis; Hydromyelia; *Hydrorhachis Interna*; Central Gliomatosis; Fr. *Myélite Periépendymaire*; Ger. *Syringomyelie.*

This condition has been long known on its pathological side, but it has been only of late years connected with anything like a definite symptomatology. Formerly, therefore, the disease was never diagnosed during life; the morbid condition was only recognised after death as the cause of previously obscure and little-understood symptoms. During recent years, however, it has been otherwise—diagnoses have been made during life and subsequently verified.

Ætiology and Pathology.—There are two principal conditions in which cavities are found in the spinal cord; and though in their typical forms they may be quite distinct from one another, in many other cases they exist in combination and are not separable conditions. The simpler condition is known as *hydromyelus* or *hydromyelia*—a state in which there is a dilatation of the central canal of the cord, and in which this canal is distended with fluid; this being either a congenital condition, or perhaps a result later in life of the pressure of a tumour on a portion of the central canal, which obliterates it at the seat of pressure, and leads to the dilatation above. The more complex condition is what is known as *syringomyelia*, in which, though there is dilatation of the canal of the cord as before, there is also a gliomatous overgrowth or new-formation around this dilated canal, which extends more or less into different parts of the posterior half of the cord.

It is commonly supposed that there is some congenital defect in the structure of the cord in these latter cases, so that the central canal remains large, and has around it a variable amount of the unaltered embryonal tissue of the organ, closely allied in structure to the neuroglia, some amount of which always exists at the surface of the cord as well as around its central canal. At some variable period in the life of the individual (but mostly between puberty and the twentieth year) growth seems to take place to a more or less marked degree in this embryonal tissue, resulting in the production of a gliomatous new-formation, which infiltrates to a variable extent the grey matter, and also the posterior and postero-lateral columns. The symptoms of the disease are thus gradually produced by the increase and invasion of the new-growth, and they will naturally vary in their rapidity of evolution with the rapidity or otherwise of increase in the new tissue itself. Cavities other than the enlarged central canal are frequently found co-existing with this gliomatous new-formation, which have probably been formed therein by degenerative changes.

The dilatation of the central canal sometimes exists throughout the entire length of the cord, and there may likewise be a dilatation of the *iter* between the third and fourth ventricles of the brain. In other cases—and this is the most frequent condition—the cavity only involves the cervical and the upper dorsal region of the cord, or perhaps a still more limited longitudinal area. The transverse section of the cavity may be oval or circular, whilst in other cases there are narrow chink-like extensions into one or both posterior cornua. Other independent more or less chink-like cavities are also frequently found, which are supposed to have resulted from degenerative processes or from hæmorrhages occurring in the new gliomatous tissue.

In brief, the condition seems to be due in the first place to a congenital arrest of development, supplemented most frequently somewhere between the fifteenth and the thirtieth year, without assignable cause, by an overgrowth of gliomatous tissue of varying extent and rapidity around the dilated central canal and into contiguous regions of the cord; the symptoms being due in the main to this latter process, to pressure occasioned by the fluid or by the new tissue itself, as well as to the subsequent changes taking place in the infiltrated regions of the cord.

Symptoms.—The symptoms of the disease often begin between the fifteenth and the twentieth years (rarely later than the thirtieth), and they may continue for ten to twenty years before a fatal termination occurs.

Patients complain of variable pains in the cervico-scapular region, and some amount of muscular atrophy soon shows itself about the arms or shoulders. Occasionally there may be atrophy also of some of the muscles of the leg.

The arms, or arms and legs, also become more or less weak; the deep reflexes are exaggerated; and some amount of rigidity may likewise show itself in the lower extremities.

With these symptoms there are very characteristic modifications of sensibility. Tactile sensibility and the muscular sense may be little if at all impaired, but painful and thermic impressions (which are conducted to the brain through the central regions of the cord) are lost in one or both arms and in contiguous parts of the trunk. The distribution of the areas affected by this loss of sensibility varies much in different cases; sometimes they are unilateral and sometimes bilateral. In one case under the writer's care the whole of the trunk and the two upper extremities were involved, except for a broad band about six inches wide which encircled the body just above the level of the umbilicus. Less frequently, and mostly in the later stages of the disease, there may be complete anæsthesia of the skin and mucous membranes over the whole or part of one side of the body. The special senses are generally unaffected, and power over the sphincters is also unimpaired. Some of the ocular muscles may be weakened or paralysed where the dilatation of the central canal extends upwards so as to affect the *iter*, and is so great as to lead to pressure upon some of the contiguous nuclei for the ocular nerves. Under similar conditions nystagmus may also not infrequently be present.

Trophic troubles, other than the muscular atrophy, are not at all uncommon in the course of this disease. In the first place it may be said that such patients frequently burn themselves about the upper extremities, owing to the loss of painful and thermic sensibility. Other changes, however, occur spontaneously, such as alterations of the joints of the tabetic type, or ulcerations of the skin. In these cases it may be suspected that affections of the peripheral nerves are associated with the changes in the spinal cord—a combination which has been proved to exist in a remarkable variety of syringomyelia, first recognised in Brittany, and known as 'Morvan's disease,' which is characterised by neuralgic pains, cutaneous anæsthesia, and painless but destructive whitlows.

Diagnosis. — The diagnosis of syringomyelia is now fairly easy in the majority of cases. It is the combination of loss of painful and thermic sensibility, without loss of tactile sensibility, in association with muscular atrophy in the upper extremities more especially, which is characteristic of the disease.

Formerly this affection was sometimes confounded with anomalous cases of disseminated sclerosis, though such a mistake is much less likely to occur now. It bears most resemblance to certain cases of 'hypertrophic cervical pachymeningitis' (*see* Meninges, Spinal, Inflammation of), though these latter cases may usually be distinguished by the greater amount of pain in the nape of the neck and in the upper extremities, together with a certain amount of spasm, and the loss of tactile as well as other modes of sensibility, instead of the dissociated anæsthesia so characteristic of syringomyelia.

Prognosis.—The prognosis is hopeless as regards cure or control of the disease, but the affection is a very chronic one, and therefore not specially dangerous to life till a rather long series of years has elapsed.

Treatment. — Treatment can only be directed to the maintenance of the general health, and to the alleviation of pains where they are distressing by means of acetanilide or of morphine. Massage and electrical treatment may also be of some use during the early stages of the disease.

H. Charlton Bastian.

22. **Spinal Cord, Malformations of.** Various conditions are comprised under this head which are of little or no interest to the practitioner. The spinal cord may be absent, imperfectly developed, or double. Again, cases occur in which the spinal cord is either unduly long or unduly short, or in which it may present some trifling lack of symmetry. One of the most interesting of these latter conditions is due to the fact recently discovered by Flechsig of the possible non-uniform distribution of the pyramidal tracts upon the two sides of the cord, so that the amount of decussation of the motor fibres, not only in different individuals, but also in the two halves of the same cord, may be quite unequal. In the latter case a slight asymmetrical development of the antero-lateral columns on the two sides would be met with.

Congenital Dilatation of the central canal of the Spinal Cord (*Hydrorhachis interna*, or *Hydromyelus*) has already been referred to as constituting one side of the disease described as 'Syringomyelia'; in which, however, other cavities are frequently found resulting from the breaking-down of the gliomatous new-growth.

Congenital dilatation of the central canal in its most developed form is apt to be met with also in some cases of *spina bifida*; whilst in others the canal in the lumbar region is open posteriorly, and the halves of the posterior columns are more or less widely separated; there is, in fact, a congenital arrest of development in the spinal cord very similar to that which exists in the spinal canal. *See* Spina Bifida.

H. C. B.

II. Diseases of the Spinal Cord dependent upon unknown, or very imperfectly known, organic changes.

23. **Tetanus.**—*See* Tetanus.

24. **Tetany.**—*See* Tetany.

25. **Torticollis.**—*See* Wry-Neck.

26. **Writer's Cramp, &c.**—*See* Writer's Cramp.

27. **Spinal Irritation.** — *See* Spinal Irritation.

28. **Reflex Paraplegia.** — Synon.: Urinary Paraplegia (in part); Fr. *Paraplégie Reflexe*; Ger. *Reflexlähmung.*

General Remarks.—Some practitioners believe that paralyses of various kinds are brought about purely by reflex influences. They would include under this category some of the cases of paralysis of separate muscles, such as the ocular; some cases of paralysis of one or both arms; or some of the cases of paralysis of one or both lower extremities. It is the latter class of cases with which we are now specially concerned, though most of what is to be said in the present article may, *mutatis mutandis*, be considered applicable to the whole class of so-called 'reflex paralyses.'

Those who believe in the frequent existence of this form of paralysis are considerably less numerous than they were about thirty years ago, when the notion of its frequency and importance was warmly espoused by Brown-Séquard (*Lects. on Paral. of Lower Extremities*, 1861), at a time when the morbid anatomy of the spinal cord was still very imperfectly known. The number of competent observers was then smaller, and the difficulty in detecting morbid changes in this organ was also much greater than it is at the present time, when we are accustomed to employ more elaborate methods for its preservation and for its examination. Yet one of the strongest of the arguments brought forward in favour of the existence of 'reflex paraplegia' was the absence of discovered lesions in the spinal cord in a class of cases reported upon by Stanley in 1833 (*Med.-Chir. Trans.*, vol. xviii., p. 260), in which paraplegia was associated with various morbid conditions of the urinary organs—cases, in fact, of the so-called 'urinary paraplegia.' And one of the main supports for the opinion of those who still believe in the existence of a class of reflex paraplegias would even now lie in the absence, in certain cases of paraplegia terminating fatally, of any actually discovered lesion.

Ætiology and Pathogenesis.—The interpretation of the paralyses of this class put forward by Brown-Séquard was as follows: That an irritation, operating upon certain sensory nerves, produced impressions which, after impinging upon the properly related grey matter in the spinal cord, are thence in part reflected along vaso-motor nerves regulating the calibre of certain blood-vessels which supply either (*a*) the portion of the spinal cord in relation with the paralysed parts, or else (*b*) the great nerves or the muscles themselves of the paralysed parts. In either case this reflection of impressions resulting from irritation of sensory nerves, upon such special groups of vaso-motor nerves, is supposed to lead to a persistent spasm of the vessels which they innervate, so as to cause a continuous anæmic condition, either of certain vascular territories in the spinal cord itself, or else of the related nerve-trunks and muscles. In either case, too, the nutrition of the parts involved in this anæmia is supposed to suffer—so that their functions can no longer be carried on, or only in a very imperfect manner—and thus a more or less complete paralysis results, which is capable, however, of being mitigated from time to time, of actually intermitting, or indeed of being abruptly cured, according as temporary diminutions or a complete disappearance of the original exciting cause may lead to a diminution or to an actual cessation of the supposed profound anæmia produced by the postulated spasms of vessels. These are the theories upon which the doctrines of 'reflex paraplegia' are based.

Among the sources from which the initial irritation is supposed to proceed, almost all parts of the body, internal as well as external, are included. Thus irritative impressions, it is thought, may emanate from almost any part of the urinary tract—from the urethra to the kidney; in other cases similar impressions may emanate from some portion of the female genital organs; in others from the intestinal canal, owing to the presence of worms or some such persistent causes of irritation; in others from some portion of the thoracic organs; or, as it seems to be held, from irritated sensory nerves in almost any part of the body, whether situated near the surface or deep amongst the tissues.

The assemblage of symptoms supposed to characterise these forms of reflex paralysis presents nothing like a distinctive mode of grouping. And of the several components of the group put forward by Brown-Séquard in 1861 (*loc. cit.*, p. 33), as pertaining to one of the most typical varieties, namely, 'urinary paraplegia,' none can now have any pretensions to be regarded as distinctive, excepting the alleged tendency of the paralysis to vary in degree with variations in the malady on which it is supposed to depend, together with its tendency to spontaneous or easy cure coincidently with or soon after the cessation of the urinary troubles, whatever they may have been. In harmony with this latter character also are the alleged facts that speedy cures have been brought about of cases of paraplegia, especially in children, after the expulsion from the alimentary canal of tapeworms or round-worms; or of cures of the same disease in adult females after the cessation of some uterine inflammation; or of cures of a paralysis of ocular muscles after the removal of some carious tooth which had previously been exercising an irritative influence upon branches of the dental nerve.

It would be useless to attempt to deny the existence of such cases; they are theoretically possible. On the other hand, the writer is compelled to believe, after a very extensive experience, that, if they exist, they can only occur as extremely rare events.

Although it is theoretically possible that an irritation of a sensory nerve may be reflected on vaso-motor nerves, so as to lead to arterial spasms in certain territories of the spinal cord, or in certain groups of muscles, it is difficult here, as it is when postulated in explanation of other functional diseases of the spinal cord, to imagine that such a condition of spasm could be maintained for weeks or even months. Nor, if it could occur for these prolonged periods, and to such an extent as to annul some of the most important functions of the spinal cord during this time, is it at all clear that the nutrition of the cord in the affected regions would not be seriously interfered with by such prolonged anæmia; and, if so, the assumed speedy resumption of healthy functions *pari passu* with the diminution or disappearance of the vascular spasms would constitute another difficulty, since such speedy recovery would be scarcely compatible with the theory upon which the explanation of the disease is based.

Again, it is almost certain that many of the cases formerly supposed to belong to this category of 'reflex paralysis' had no right to figure therein. Cases of diphtheritic paralysis have been proved to belong to a different category; and there is good reason to believe that in other instances the morbid conditions really existing as causes of the paralysis have simply been overlooked, either because the appreciable changes were only slightly advanced at the time of the patient's death (owing to the brief duration of the illness); or because of the want of a thorough examination of the cord, conducted with all needful aids, care, and expenditure of time; or, finally, because the disease may have been in the peripheral nerves rather than in the spinal cord itself.

It seems clear, therefore, that the opinions of those who believe in the existence of 'reflex paralysis,' and of 'reflex paraplegia' in particular, stand much in need of further support and definition. Well-observed and well-recorded instances of the disease are urgently wanted, if reflex paraplegia' is to retain its claim to a place in our nosology.

H. Charlton Bastian.

29. Intermittent Paraplegia.—Synon.: Intermittent Spinal Paralysis; Fr. *Paralysie Spinale Intermittente*; Ger. *Intermittirende Paralysis Spinalis.*—Very few cases of paraplegia of this type have been recorded, and it must also be a condition of extreme rarity.

The earliest recorded example was made known by Romberg, and as this, both in its nature and its course, seems to have been a typical instance, it may be cited here. 'A woman, sixty-four years of age, after being quite well the day before, was suddenly attacked with paralysis of the lower extremities and of the sphincters. Sensibility was unchanged, consciousness clear, the temperature cool, pulse 80, small and empty, no pain in the spinal cord. The next day there was an astonishing change in the condition. The patient could walk again and void urine voluntarily, and only complained of weakness in the legs. The following morning there was paraplegia again, which had set in at the same hour as it had done two days before. A third paroxysm was awaited, which also set in at the appointed time, although without paralysis of the sphincters. Quinine effected a rapid cure.'

Additional cases have since been recorded by Erb, Hartwig, and other observers; and the view now entertained concerning them is that they are due to multiple neuritis or to a multiple peripheral neurosis, rather than to any disease of the spinal cord itself. *See* Neuritis, Multiple.

Any future cases deserve to be observed and recorded with the greatest care. Meanwhile it should be remembered that those already observed seem to have proved extremely amenable to the influences of quinine and of arsenic.

H. C. B.

30. Functional Paralysis of Spinal Type.—Synon.: Hysterical Paraplegia.

It is generally admitted that paralyses of the 'hysterical' type more frequently belong to the paraplegic than to the hemiplegic variety. Even good observers, however, are rather too prone to look upon the terms 'functional' and 'hysterical' as interchangeable. This is apt to create confusion. Surely there may be functional paralyses which have no right, merely as such, to the appellation 'hysterical.' Certain it is that in a considerable proportion of cases, which we seem justified in regarding as functional, there may be, apart from the paralysis, no symptoms or mental peculiarities which could be described as 'hysterical.'

This whole subject bristles with difficulties, for, as the writer has recently endeavoured to point out (*Various Forms of Hysterical or Functional Paralysis*: London, 1893), the different forms of functional paralysis must be dependent upon faulty nutrition and faulty functioning (apart from gross organic disease) of this or that territory of the brain, and probably also of this or that region of the spinal cord. This being so, functional paralyses should closely accord in their characters with the forms of paralysis caused by actual gross lesions in different regions of the brain and spinal cord; though the two classes may differ in severity and in curability—one or both.

'Some appear to think (or their language seems to imply) that all cases of paralysis not due to a structural cause must be of a hysterical order; and, as they believe hysteria to be due to a perverted activity of the brain, it perhaps never occurs to them to consider whether some of the cases of functional paralysis coming before them may not have their origin in a depressed or perverted activity in some portion of the spinal cord. For one or other of these reasons, it happens that up to the present time almost nothing has been said upon this subject; so that no rules of any kind are laid down in our textbooks to help us in distinguishing spinal from cerebral cases of functional paralysis.'

Symptoms.—It seems clear, however, that, if there are in reality cases of functional paralysis of *spinal type*, they at least could have no sort of right to be spoken of as 'hysterical,' seeing that hysteria is now generally admitted to be a functional disease of the brain. The writer believes that such cases are to be met with not infrequently, and for the present he is disposed to range them tentatively in two classes, viz.:—

A. *Cases of the Spastic Type, due to functional perversion or defect in some part of the pyramidal system of fibres in the spinal cord.*

B. *Cases of the Flaccid Type, due to functional defect in the anterior cornua in certain segments of the spinal cord.*

In both sets of cases there is mostly a complete absence of ordinary hysterical symptoms. Instances of Class A approximate somewhat in their symptoms to those of 'spasmodic spinal paralysis'; that is, there is paresis or actual paralysis, with more or less of rigidity and of exaggerated reflexes in the lower extremities. Defects of sensibility may or may not be present in the paralysed parts and over the trunk to a certain level, though the distribution of anæsthesia is often unequal on the two sides of the body.

In Class B we have to do with cases of paralysis of flaccid type unassociated, it may be, with any diminution of muscular sense. But in other of these cases, where the functional defect is more diffused over the grey matter rather than limited to the anterior cornual regions, there may be a more or less marked impairment of common modes of sensibility, and possibly also some amount of diminution of muscular sense owing to interference with its afferent channels. It may, perhaps, be assumed that the functional defect in the anterior cornua of the cord is adequate to bring about a more or less definite paralysis, even though the defect may not be sufficiently severe to entail any special muscular atrophy.

DIAGNOSIS.—The characteristics of hysteria and of hysterical paralysis have been set forth elsewhere (*see* HYSTERIA); it must suffice, therefore, to say here that true hysterical paralysis (whilst it may be hemiplegic or paraplegic) is very frequently associated with a hemianæsthesia of cerebral type (in which the special senses are more or less involved), whilst there may be the association of hysterical convulsions, and more or less special mental peculiarities. In the cases of functional paralysis of spinal type, however, with which we are now concerned, there is an absence of these associated symptoms; anæsthesia is not always present, and when it is it does not affect the head and face, with the special senses. Future investigation will probably lead to the recognition of other more definite differences between these two classes of functional paralysis.

In the diagnosis of these cases, reliance is always to be placed principally upon the absence of distinct evidence of organic disease such as would be furnished by muscular atrophy together with the electrical reaction of degeneration, by incontinence of urine or of fæces, and by the occurrence of bed-sores. The diagnosis has, in fact, to be made by way of exclusion; we must be satisfied that the symptoms in the case before us are not explicable by supposing the existence of any known organic disease of the spinal cord.

It may be said, moreover, that the cases of organic disease which are most likely to be confounded with functional paralyses, whether of cerebral or of spinal type, are spasmodic spinal paralysis, disseminated sclerosis, subacute or chronic spinal paralysis, Friedreich's disease, or the paralysis associated with Pott's disease. In many cases, however, such mistakes are made as much from the want of a sufficiently thorough examination of the patient, as from defective knowledge of the respective characteristics of the organic diseases just named.

PROGNOSIS.—The prognosis is of course always very much more hopeful in functional cases than it would be in anything like corresponding cases due to organic disease. The ultimate establishment of a cure may be considered the rule in cases of functional paralysis, of this as well as of other types, provided the cases come under systematic and efficient treatment; though the duration of the disease must be considered to be altogether uncertain. Sudden cures are not to be expected in this class of cases as frequently as they are in the functional paralyses of cerebral type. For the most part they will require many weeks or months of continuous treatment before the patient slowly recovers.

TREATMENT.—This must be conducted upon very much the same principles that are applicable to the treatment of functional paralysis of cerebral type, so that details need not be here recapitulated. *See* HYSTERIA.

H. CHARLTON BASTIAN.

31. Paraplegia Dependent on Idea.

NATURE AND ÆTIOLOGY.—This is a form of paralysis, of purely 'functional' type, occasionally occurring in neurotic impressionable persons, and yet not dependent upon any ordinary hysterical condition. Attention was first called to such cases by Dr. Russell Reynolds, who cited, amongst others, a typical instance in which a young lady, whilst attending to a paraplegic father, amidst the additional anxieties consequent upon straitened circumstances and the fatigues incident to teaching in order to obtain the bare necessaries of life, became at last, under the influence of long-continued strain, together with an abiding fear (inspired by actual physical weakness) that she herself was becoming paralysed, reduced *de facto* to this condition, as the final outcome of a slowly increasing weakness (see *Brit. Med. Journ.*, Nov. 6, 1869).

Pathology.—Such a condition may occur quite independently of hysteria, and be just as free from anything like conscious simulation or desire to exaggerate. We cannot say positively that the state is induced by what is called 'inhibition,' or by definite vascular spasms such as are supposed to form one of the pathological bases of the class of so-called 'reflex' paralyses, and yet both these modifying influences over the functional activity of the spinal cord *may* be in part operative when imagination, continuously excited in some one direction, has a tendency to pervert the functional activity of this portion of the nervous system.

The same conditions that exist as more lasting states in these cases probably exist temporarily, under the influence of suggestion, in hypnotised persons. *See* Magnetism, Animal.

Symptoms.—There is a paralysis of motion in the lower extremities, more or less complete, often partial, and generally without implication of sensibility. There is unabated control over the bladder and rectum.

Dr. Reynolds points out that, while such patients may be wholly incapable of lifting a foot from the bed, they often find themselves able to turn or sit up without any assistance. And in slighter cases, though they may be unable to stand for a moment, such patients may yet be able to move the legs in any direction while in the recumbent position.

Diagnosis.—The character of the paralysis, and its limitation in range, is thought to be of importance. But still more important is the establishment of the fact of the pre-existence of long-continued fears or fancies (in a person of delicate or neurotic temperament), of such a nature as to be in accordance with the patient's now-present condition, combined with the absence of all signs positively indicative of any structural defect in the spinal cord.

Where such a condition exists (as it may) as a mere complication of an actually existing structural disease, the diagnosis becomes either impossible or extremely difficult. It is, in fact, only possible after prolonged observation and experience as to the course of the symptoms.

Prognosis.—The prognosis is extremely good if the nature of the malady be divined, and a right course of treatment adopted. Under such circumstances, an almost complete cure may easily be brought about in a week or ten days; but, failing this recognition, the morbid condition may, it is said, under ordinary treatment, persist for an almost unlimited period.

Treatment.—The practitioner must inspire the patient with confidence that the malady is curable, and surround her (or him) with cheerful, hope-inspiring attendants and influences. At the same time, with the view of supporting her confidence (if for no other reason), he should faradise the muscles of the apparently paralysed limbs daily, or have recourse to frictions or massage combined with passive movements. He must make the patient attempt to stand or walk, with the necessary support; administer opiates, or bromide of potassium with chloral, to procure sleep, if necessary; and carefully seek to restore the patient's general health and nutrition. In this class of cases, especially, it would seem probable that the influence of 'suggestion,' if hypnotism could be induced, might be capable of producing an almost immediate cure.

H. Charlton Bastian.

32. **Neurasthenia Spinalis.**—Synon.: Functional Nervous Weakness of the Spinal Cord.

Nature and Ætiology.—Under this name, descriptions have been given of a combination of symptoms not infrequently met with in males as well as females, but more especially in the latter. They are supposed to represent a condition of extreme nervous debility, coming on obscurely, or at all events not as a sequence of some previous severe illness or shock. Still the symptoms met with often approximate closely to those pertaining to a state of convalescence from some serious febrile illness; and are not at all unlike some of those which may follow concussion of the spinal cord.

Such symptoms, when occurring independently, are most prone to show themselves in those who are naturally of a neurotic temperament. They may be excited by over-fatigue of various kinds, especially when this has been coupled with disturbed sleep for some time. Prolonged exercise or mental overwork may have been the particular exciting cause of fatigue; though perhaps much more frequently this is to be found in sexual excesses (of a natural or unnatural order), either extending in the form of habitual indulgence over a considerable period, or as more isolated but marked excesses. At other times, symptoms of neurasthenia spinalis set in without obvious provocatives of either type.

Pathology.—Concerning the actual cause of spinal neurasthenia little or nothing can be said. Sometimes there may be the co-existence of distinct cerebral symptoms of an analogous type; though on other occasions the symptoms are more purely spinal. This malady is perhaps capable of being induced by mere altered molecular states and actions of the tissue-elements of the spinal cord. A kind of persistent 'fatigue condition' exists. Although some may imagine the existence in these cases of a more than usually anæmic condition of the spinal cord, of this, as a fact, there is no evidence. To speculate upon other modes in which such a set of symptoms might be brought about would, in the present state of our knowledge, be of little service. There is, however, the possibility that this morbid condition may be due in the main to a functional disease of the cerebellum—especially if the views of Rolando and others, as to the functions of this great organ, should prove correct even in part.

Symptoms.—A feeling of utter weakness and prostration, induced by even the smallest amount of muscular exertion, is the central symptom, though this is usually associated with coldness and more or less numbness of the extremities. Pains, too, may be felt in the muscles of the limbs and in some parts of the back, though there is commonly no tenderness over any part of the spine. These symptoms may be unusually distinct after any activity of the genital function, and they may then be associated with extreme wakefulness, or sometimes with protracted inability to sleep. Occasionally, and especially when this latter symptom is not present, the patients may present a florid and fairly healthy appearance, strangely at variance with the extreme debility complained of.

Diagnosis.—The points of greatest importance are the existence of extreme weakness, with no evidence of anything like actual paralysis, or indeed of any symptoms which would indicate an actual structural disease of the spinal cord. This being so, and diabetes being also eliminated, we may oftentimes (and especially where the existence of one or other of the above-mentioned exciting causes has been established) pretty confidently conclude that we have to deal with what is here named 'neurasthenia spinalis.'

Prognosis.—A relief of this condition is ultimately to be looked for under the influence of rest and suitable treatment; but in regard to the rapidity with which any such amelioration of the patient's symptoms is to be brought about, great differences exist in different cases. Weeks, months, or even years may be required before a natural amount of vigour is restored.

Treatment.—Rest, especially in the direction of previous excesses, is the first and indispensable requisite. Every effort should be used to obtain regular and sound sleep. The action of these potent restoratives should be supplemented by a generous and easily assimilable diet, together with a moderate amount of stimulants. Hypophosphites of the alkalis with iron and small doses of strychnine (which may be conveniently given in the form of a syrup) often prove decidedly beneficial. An abundance of fresh air is desirable, and especially that of elevated and bracing mountain situations. Daily frictions and massage, aided by stimulating saline baths, may also prove to be of much use; whilst in the more severe cases a complete course of Weir-Mitchell treatment is indicated. H. Charlton Bastian.

33. Toxic Spinal Paralysis.—Under this name it will be right to refer to a class of cases of paraplegia produced by poisons of various kinds. It constitutes a somewhat heterogeneous group, concerning which our knowledge is still very defective.

Of the toxic agents taken into the body, and capable of entailing a paraplegia, some are minerals such as arsenic and lead; others are of vegetable origin, such as aconitine, conine, veratrine, prussic acid, ergot, and alcohol; whilst others again are of animal origin. In the majority of cases, their action as 'causes' is not sufficiently potent to lead to paralysis as anything like an invariable effect. They need the concurrence of other favouring circumstances, probably in the main intrinsic; but under the combination of conditions thus resulting a paraplegia may be induced. It is only in this attenuated sense that the above-mentioned poisons are to be regarded as 'causes' of paraplegia. They ought perhaps, from this point of view, to be considered as predisposing rather than as exciting, and in no case as proximate, causes of paraplegia.

Moreover, investigations that have been made during the last few years have shown that these various poisons act more powerfully upon the peripheral nerves than upon the spinal cord itself. So that cases of paralysis due to lead, arsenic, or alcohol, may be in the main occasioned by changes in the peripheral nerves (*see* Neuritis, Multiple), although some changes in the spinal cord may also co-exist, which vary in their nature in different cases. They mostly take the form of atrophy of the ganglion-cells in the anterior cornua, with some amount of surrounding sclerosis, though occasionally minute foci of softening may be met with.

Besides the more specific effects of lead in producing the above-mentioned changes in the peripheral nerves and spinal cord, it commonly induces a condition of lowered vitality which favours the development of degenerative conditions in the spinal cord. In such cases it can generally only be considered as one among other determining conditions, tending to bring about some form of paralysis. In this way it has seemed to the writer to be occasionally one of the concurrent causes in the production of primary lateral sclerosis or of progressive muscular atrophy.

These considerations will help to account for the fitful and irregular manner in which arsenic, lead, or alcohol (and probably to a similar extent other toxic substances) give rise to *paraplegic* symptoms in those who have taken them to excess. Thus, according to Tanquerel des Planches, out of 200 cases of lead-poisoning, in only fifteen did the paralysis implicate the lower extremities; and in only one of these did it occur as a distinct paraplegia. This case might, therefore, have been a coincidence rather than a definite result of the taking of lead. Again, in regard to arsenic, it is true that in certain cases Orfila observed paraplegic conditions in dogs which had taken large quantities of this drug; but such symptoms would seem to be met with only occasionally as a result of acute arsenical poisoning in man, and with equal rarity in those who habitually consume large quantities of this substance.

The notion was advanced by Moxon that a certain class of poisons, which own the common property of being 'depressants of the circulation,' have a tendency to paralyse the hind-legs rather than the fore-legs of animals. In this group are included aconitine, conine, and possibly also veratrine, chloral hydrate, and prussic acid. He was of opinion that these drugs act by causing further impediments 'to the exceedingly and peculiarly difficult blood-supply of the caudal end of the spinal cord' (*Brit. Med. Journ.* April 2, 1881, p. 498). It should be borne in mind that extreme feebleness of blood-current is of itself a common cause predisposing to the occurrence of thrombosis both in arteries and in veins, and that such a condition may intervene in some of these cases of poisoning, and lead to the development of paraplegia. This would enable us to account for the otherwise inexplicable fact of the maintenance of the paralysis long after other effects of the poison have passed away.

PROGNOSIS AND TREATMENT.—The prognosis in this class of cases is generally good. Often, indeed, the mere cessation from the consumption of the poison, aided by favourable conditions for the maintenance of the general health, suffices to restore the patient to health. In the more severe cases, however, the treatment has to be prolonged, and we must avail ourselves of all the local measures indicated in the article NEURITIS, MULTIPLE, in order to bring about a very gradual restoration of the patient's strength.

H. CHARLTON BASTIAN.

SPINAL IRRITATION.—SYNON.: Rachialgia; Fr. *Rachialgie*; Ger. *Rückgratschmerz.*

DEFINITION.—Notwithstanding the doubts that have been entertained by many authorities, both British and foreign, spinal irritation is an affection which has a real existence and deserves a special name. Although spinal irritation may be, like other affections, allied with, or caused by, various organic or functional nervous diseases, the name ought to be kept for a special spinal complaint, chiefly characterised by a morbid excitability of the sensitive nerves of the spine, manifesting itself by spontaneous pains, and by tenderness under pressure or when the affected parts are moved.

ÆTIOLOGY.—Rachialgia is more common in certain countries than in others—more so, particularly, in Great Britain, Ireland, and the United States than in Continental Europe. This probably accounts for the fact that this affection was first studied and described by a number of Irish and American writers. Sex is an important ætiological element: out of 304 cases collected by the two Griffins and by Hammond there were only forty-two men. The writer has seen it in five men only out of more than eighty cases. It occurs chiefly in girls between fifteen and twenty-five. As regards other causes, the most important are excessive walking or driving; violent movements of the spine, or a blow upon it; abuse of sexual intercourse; masturbation; and severe diseases, such as typhoid fever, scarlatina, fever and ague, dysentery, and diphtheria.

ANATOMICAL CHARACTERS AND PATHOLOGY. In simple rachialgia there is no organic alteration that the naked eye can see, or the microscope can show. At most a congestion is sometimes found. Still, organic affections of the spine and its fibrous tissues may give rise to this neurosis, so that a necropsy may show pathological alterations of various kinds in these parts. As regards the physiological pathology of spinal irritation, the symptoms belong to two distinct groups, one composed of local morbid manifestations, and the other of distant ones. As regards the first of these groups, it includes tenderness and the various kinds of pain; there is, in a measure, some similitude between these symptoms and those of neuralgia. The tenderness especially is often similar to that which is detected in some points of a nerve attacked with neuralgia. But there are differences (especially as regards the kinds of pain) which prevent a complete assimilation of rachialgia with a common neuralgia. The group of symptoms appearing at a distance from the spine is composed of reflex or direct effects of irritation of the spinal nerves. Among these symptoms we find referred sensations, muscular spasms, increased tonicity, contraction or dilatation of blood-vessels, trembling, alterations of secretion and nutrition, palpitations or inhibition of the heart, disturbances of breathing, and various others.

Sir Richard Quain communicates to the writer his conviction that spinal pain and tenderness exist more often as transmitted or referred phenomena connected with morbid states of mucous membranes than is generally recognised. Thus he finds pain present over the posterior cervical region in cases of congestion or follicular disease of the mucous membrane of the pharynx and adjacent parts. In the dorsal region the like pains and tenderness are constantly found in cases of gastrodynia, associated, it may be, with morbid states of the mucous membrane of the stomach. In the lumbar and sacral regions similar conditions are traceable in connexion with disordered states of the mucous membrane of the intestines, or of the urinary and genital organs. As we find extreme sensitiveness of the retina in cases of disease of the conjunctiva, or as we find pain at the end of the penis in cases of stone in the bladder, so may we have many of these other reflex or referred troubles in connexion with distant disorders.

SYMPTOMS.—*Spinal tenderness.*—This is the essential and only constant feature of rachialgia. Its existence, however, might not be found out if questions were merely asked, or a cursory examination were made, as the symptom may be slight and localised in, or rather around, one vertebra, and the patient may not be aware of its presence. It may be found in any part of the spine, and correspond to only one, to many, or even to all of the vertebræ. When very limited, tenderness exists more frequently at the lower part of either the dorsal or the cervical region, less often in the latter. The symptom is elicited in two ways—by pressure or by movement. When the tenderness is slight, pressure will succeed in showing its existence, while a movement might prove ineffectual. It is essential to be extremely cautious in making pressure, as not only a considerable and lasting pain may result from sudden and great pressure, but very serious convulsive, paralytic, or psychic manifestations may be produced. The writer has seen cases in which attacks of catalepsy, of tonic, clonic, or choreic movements, of temporary (and in one case of prolonged) paralysis of the lower or upper limbs, of exophthalmos with mental disorder, and the like, had been caused by heavy pressure on the cervical or dorsal vertebræ. Usually the place where pressure gives rise to the greatest pain is the spinous process. Sometimes, however, the disorder is unilateral, and then the seat of greatest tenderness is the transverse process. Very frequently myalgia co-exists with rachialgia, and then the muscular masses so attacked, on one or on the two sides of the spine, are very tender under pressure. There is often hyperalgesia of the skin itself; and the writer found this so great in one case, that any unexpected touch, or even a gentle breath of air on the skin, made the patient (a strong and courageous man) scream out. The tactile hyperæsthesia in that case was also so great that the two points of the æsthesiometer, which on the spine are felt by a healthy person only when distant one from the other at least an inch and a half, were distinctly recognised when distant less than a line, that is, when almost touching each other. In a number of cases sensibility is morbidly increased in every nerve-fibre of all the tissues of one or more vertebræ and of the neighbouring parts. There is no absolute relation between the pain caused by pressure and the constant spontaneous pain existing in many cases, as there may be considerable tenderness without any, or with very little, spontaneous pain, and there may be only moderate tenderness although a constant or almost constant severe pain is complained of.

Tenderness is often discovered by movement of the spine performed voluntarily or involuntarily by the patient, or produced, for diagnosis' sake, by the physician. Generally, however, the pain thus generated is somewhat different from that due to pressure on the spinous processes, and is chiefly, if not only, an increase of the constant spontaneous pain.

Pains referred to the periphery of the body or to internal organs are often associated with local tenderness developed by pressure. These transmitted pains, as well as the local pains caused by pressure, may last for hours, or even for days, showing how carefully the examination for tenderness should be made. It is well, when we have to deal with hysterical or timid patients, to judge of the degree of tenderness more from the sudden and involuntary movement of the spine, when we press upon it, than from the patient's statements as regards the degree of local or referred pains felt. The amount of blushing of the face when a tender spine is pressed upon is also a means of appreciating the degree of tenderness, especially when the affected part is in the lower third of the cervical region, or the upper third of the dorsal region.

Spontaneous spinal pain.—This symptom is less important than tenderness, because it is not constant, and also because it often exists in organic spinal complaints. It is increased in most cases by pressure on the spine or by movement of it. According to Dr. Hammond's observation, it is found in about one case out of three of spinal irritation. The writer believes that its frequency is much greater. It is quite variable in its character and degree. It may consist only or chiefly in a feeling of heaviness, of coldness, of heat, of pricking, or of itching. In many cases it increases, in some cases it decreases, when the sitting or standing posture is assumed. Lying flat on the back usually diminishes it, but sometimes increases it. Its seat is generally at the point where the spinal nerves emerge from the spine, resembling in this respect a neuralgic pain.

Functional disturbances of the viscera.—Rachialgia is often followed or accompanied by various functional disorders, more or less directly caused by it. The stomach and the heart are the parts chiefly affected; but other viscera (the liver, the kidneys, or the bowels) are also sometimes affected.

Vaso-motor disturbances.—These may appear anywhere, but the face exhibits them more often and more intensely than other parts. They consist chiefly in alternations of great paleness and flushing.

Motor disturbances.—A fixed contraction of some muscles, especially in the forearm, has been pointed out by Mr. Teale. The late Dr. C. B. Radcliffe said that this contraction does not disappear during sleep. This slight rigidity increases when an effort is made to loosen it. A great variety of other motor disturbances may appear in this affection, as will be mentioned hereafter.

The symptoms of rachialgia necessarily vary with the different regions of the spine.

1. **Cervical Region.**—Spinal irritation is very frequent in this region, although less so than in the dorsal. More than elsewhere, pressure on the spine, when the disorder is in the neck, will produce referred sensations. For instance, pressure on the two upper vertebræ may cause pain in the forehead; pressure on the third and fourth vertebræ a pain in the pharynx; and on the last cervical a pain behind the sternum. According to the best observers, the following symptoms have been noticed in cases of cervical spinal irritation: vertigo, headache, psychical disturbances, insomnia, nightmare, neuralgic pains in the head, face, neck, shoulders, chest, and upper limbs, contraction of flexor muscles in the forearms, clonic spasms, fibrillary movements in the shoulders and arms, disturbances in phonation and deglutition, dyspnœa, spasmodic cough, fainting, and palpitation of the heart.

2. **Dorsal Region.**—This is the region most frequently attacked. The stomach is the principal seat of disturbance in dorsal rachialgia. It shows its irritation by pain, pyrosis, eructations, nausea, and vomiting. Palpitation of the heart is not rare; but dyspnœa and cough are less frequent than in cervical rachialgia. So are neuralgic pains, involuntary movements, and tonic spasms.

3. **Lumbar Region.**—Rachialgia is rarely localised in the lumbar region. It manifests itself or is accompanied by the following symptoms: neuralgia in the lower limbs, myalgia in the lumbar and abdominal regions, painful spasms of the vesical or anal sphincters, uterine and ovarian pains, with or without menstrual disturbances, and disorders of motility, such as tonic or choreic movements in the lower limbs and pseudo-paraplegia.

4. **General Rachialgia.**—It is assuredly quite rare to find every vertebra tender. The writer has seen it but twice. But it is not so rare to find cases in which almost every part of the spine is affected. Hyperæsthesia is then usually greater than in localised rachialgia. The pains produced even by the gentlest pressure on one spinous process usually extend to the whole vertebral column. The various symptoms pointed out as due to localised spinal irritation are present here together, and show themselves in the four limbs, the head, the neck, the trunk, and the internal organs—especially, however, in the heart and the stomach.

Diagnosis.—The symptoms of spinal irritation are so characteristic that it is only in cases of complication of this affection with another that doubts might arise. A sprain of the spine, intense congestion of the cellular tissue and of the muscles, and inflammation of the parts close to the spine, involving the fibrous tissue binding together the vertebræ, and due to some traumatic cause, will certainly give origin to the local and sympathetic symptoms of spinal irritation, together with those due to inflammation or considerable congestion. There cannot be a mistake. Two distinct morbid states, then, follow a blow or some other traumatic agency affecting the spine. In the same way we find hysteria coexisting with spinal irritation. Indeed, it is extremely rare to find that hysteria, beginning by any symptom, will not soon be accompanied by some degree of spinal irritation; and, on the other hand, in almost all cases of genuine spinal irritation, more or less marked hysterical symptoms will appear, so that these two affections almost always are, at least partly, blended together. The singular and rare affection described by Trousseau under the name of tetany can hardly be mistaken for rachialgia, not only because the most important symptoms of spinal irritation are absent or very slight in tetany, but also because in this last affection the muscular contraction is generally accompanied by trembling, anæsthesia, and a feeling of great fatigue. Tetanus, and the organic affections of the spinal cord and its meninges, may be put aside, as, although there may be spinal tenderness in some of those affections, especially in meningitis, the other symptoms clearly establish their existence, and not that of mere rachialgia. The same may be said of Pott's disease, or other morbid structural alterations of the vertebræ.

Prognosis.—It is impossible to agree with those physicians who take a light view of spinal irritation. Although a cure can often be obtained, and sometimes very quickly, this affection, when at all severe, will frequently resist treatment, or reappear after a temporary cure. The writer would say, however, that many patients refuse to submit to the most energetic means of treatment, and that, therefore, we cannot know what would have been their fate under better means than those used. Still, death is never caused in a direct way by this affection. Its worst feature is that it renders the patient most miserable, from pains, weakness, and the various functional disorders it produces.

Treatment.—In this affection the cause ought first to be removed, if possible. Anæmia exists so frequently, and participates so certainly in the production, or at least in the persistence, of the symptoms, that the writer can easily accept the statement of some physicians, that certain remedies, such as iron, quinine, the mineral acids, alcoholic stimulants, cod-liver oil, arsenic, and nux vomica, have been used successfully against rachialgia. Indeed, some of these means—one or another, according to special circumstances—ought almost always to be used. The writer's own experience does not confirm that of Dr. Hammond as regards the beneficial effects he attributes to zinc. Internal remedies taken by the mouth are certainly less important than external ones, or medicines used by subcutaneous injection.[1] Hypodermic injection may be used in certain cases, but with great discretion, as the habit should not be encouraged. When the pain or tenderness is localised in a small part of the spine, the writer has obtained great relief from the use of frictions with an ointment composed of aconitine, two grains; veratrine, four grains; and lard, two drachms. Every counter-irritant, including galvanism (if we can look upon it in such a way), has been used with benefit in some cases. Applications of ice and of the actual cautery will be found to be the best. Ice may be employed, finely pounded, as a kind of poultice, applied on a large surface and on the bare skin, or in frictions on the two sides of the spine, and by either process only for three to six minutes, twice a day. If there be no success by these means, the application of a very hot piece of flannel on the principal seat of pain is advisable, followed after five minutes by the application of ice according to one or other of the preceding methods. When the whole spine is tender or painful, each of its three regions should be treated, one after the other. Next if not first in importance is the use of the actual cautery, after the following rules: First, the instrument must be at *white* heat; secondly, its terminal part must have a very small surface; thirdly, it must be applied quickly although firmly; fourthly, on each day of application, three or four cauterisations must be made on each side of the spine, and these irritations must extend over two or three inches in length; fifthly, the operation is to be repeated every day for eight or ten days, care being taken that the instrument be passed each time on unaltered skin. The writer uses a Paquelin cautery, with which there is, when the above rules are strictly adhered to, neither great pain nor a sore produced. The outer layer of the skin dries up and becomes brown, but there is no blister or ulcer or purulent discharge. This is a most valuable means of treatment, especially when the pain and tenderness of the spine are intense.

If all the means already mentioned have failed, or even when they have not been tried, and when the affection occupies a great part of the spine, if the patient is quite submissive and willing to do as she is told, *absolute rest* of the tender and painful parts is to be employed. In Hilton's valuable work on *Rest and Pain*, the rules are given which must be followed in such cases. The words *absolute rest* express exactly what is needed. It would be worse than useless to make a patient with spinal irritation lie down, and stay in bed for two, three, or four weeks, if he or she were allowed to turn in bed, or to move the spine at all at the affected part. If the rest of the part is really absolute and constant, a cure is almost always obtained after a few weeks. So long as this difficult treatment lasts, every attention must be paid to the nourishment, to the state of the bowels, and to the occupation of the mind of the patient. It need not be said that other means of treatment (especially subcutaneous injections against pain) are to be used during the period of rest. Fresh air must be admitted to the room as far as the season allows. The muscles of the limbs (which are to be left without voluntary movement) are to be gently galvanised daily, so as not only to improve their nutrition, but to act also on the general circulation of the blood. On getting out of bed, when it is ascertained that both pain and tenderness have disappeared from the spine, the patient must for a time (a week or more) be most careful to avoid moving much the parts which have been affected.

The writer cannot conclude this article without referring the reader to a lecture by Dr. Weir Mitchell of Philadelphia, in which rules not essentially different from the above are given. *See* 'Rest in the Treatment of Nervous Disease,' in *A Series of American Clinical Lectures*, vol. i. No. 4; New York, 1875.

C. E. BROWN-SÉQUARD.

SPINE, Diseases and Curvatures of.

—SYNON.: Fr. *Maladies et Corbures du Rhachis*; Ger. *Krankheiten und Krümmungen des Rückgrates.*

GENERAL REMARKS.—The vertebral column is a complex anatomical structure, consisting of large masses of bone, chiefly cancellous, forming the bodies of the vertebræ; large flat discs of fibro-cartilage placed between the bodies of the vertebræ; and connecting ligamentous structures. On either side of and behind the vertebral canal, in which the spinal cord is placed, are the oblique articulating, and the spinous processes, with which are connected the large group of muscles, whereby the various movements of the spinal column are regulated, and the erect position of the body is maintained.

All these structures are liable to special forms of disease, such as are met with in other parts of the body where similar structures exist. Hence a certain analogy may be traced between the most ordinary forms of disease which occur in the spinal column, and the joint-diseases of the extremities; but the absence of articular cartilage and synovial membrane between the bodies of the vertebræ destroys much of the analogy. Nevertheless, in the ordinary form of disease of the spinal column, or 'Pott's disease,' we have, as its chief characteristics, *caries* and *necrosis* of bone, with *ulceration* of the intervertebral cartilage, accompanied by *suppuration.* The ligaments are, as in other parts of the body, especially liable to the *rheumatic* form of inflammation. The muscles are especially liable to *paralytic* and *spasmodic* affections, such as occur in the muscles of the extremities, and other parts of the body. The spine is also very liable to various forms of *curvature.* Other forms of disease, such as *tubercular deposits*, *cystic* and *malignant growths,* are occasionally met with, but do not require special description in connexion with the spinal column. The diseases of the spinal cord and its membranes are described in other articles. The only affections, therefore, which demand special consideration in this place are (1) Pott's Disease, with its resulting angular curvature; and (2) Lateral Curvature.

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[1] To this general statement an exception ought to be made in the case of remedies directed to the cure of the morbid state of the mucous membrane which may be the origin of referred spinal pains—such as nitrate or oxide of silver, bromides and alkalis combined with belladonna.—EDITOR.

1. Pott's Disease of the Spine.—

SYNON.: Kyphosis; Spinal Caries; Fr. *Mal Vertébral de Pott*; Ger. *Die Pott'sche Krankheit.*

DEFINITION.—A destructive disease of the spinal column, depending upon ulceration of the intervertebral cartilages; generally associated with caries and necrosis of the bodies of the vertebræ; and named after the distinguished surgeon Percival Pott, who first described its pathological characters.

ÆTIOLOGY AND ANATOMICAL CHARACTERS. Pott's disease of the spine may be either of *local* or of *constitutional* origin. When *local,* it results from injury; and the violence may be either *direct* or *indirect.*

The disease may commence either in the intervertebral cartilages, or in the bodies of the vertebræ. In the majority of cases ulceration of one or more intervertebral cartilages occurs, as the result of subacute inflammation; and the adjacent surfaces of the bodies of the vertebræ become destroyed by caries and necrosis. When the disease commences in the bones, primary necrosis occurs in one or more of the bodies of the vertebræ, as it is observed to do in other situations where cancellous bone exists in large masses. In a later stage, the osseous and cartilaginous structures are all involved in the destructive process, abscess may develop, and a chasm is formed in the anterior part of the spinal column, which subsequently becomes bent upon itself, the spinous processes projecting posteriorly so as to produce the distortion described as *angular curvature of the spine.* The angular form of the projection is most marked in the dorsal region, in consequence of the natural curve of the spinal column in a posterior direction, and also from the length of the spinous processes. In the cervical and lumbar regions an opposite condition obtains, and an obtuse posterior, rather than angular, projection occurs; and this may be absent, even in cases of extensive disease.

If the case proceed favourably towards a curative termination, the destructive processes become arrested, and a healthy reparative process is established, terminating in bony ankylosis between the bodies of the vertebræ, which have become approximated after the loss of structure. Ossification also proceeds along some of the ligamentous structures passing between the laminæ, as well as between the spinous processes. Thus the resulting angular, or posterior, projection becomes a persistent deformity—a deformity essential to the cure of the case.

Cases traceable to *direct violence* are of more frequent occurrence in adult life—for instance, the fall of earth from the roof of a tunnel upon the back of a man, in the stooping position; the fall of a sack of wheat upon the back of a person passing under it; or a fall from a ladder. The evidence of direct injury is not so easily obtained when the disease occurs in childhood, but occasionally we see spinal curvature developed in robust and healthy children, who have never had any previous illness, and whose family history is exceptionally good. In such cases we can hardly doubt that some slight accident, met with in boisterous play, must have been the immediate cause of the disease; and in some instances the writer has obtained undoubted evidence to this effect. The immediate symptoms are slight and transient, but in the course of a few months conclusive evidence of the existence of disease is developed.

Indirect violence frequently gives rise to Pott's disease of the spine, and in all probability lays the foundation of the mischief in the greatest number of cases, although the accident, as a producing cause, cannot be traced in every instance, especially when the disease occurs in childhood, as it most frequently does. The kind of accident alluded to is a rick or twist of the spine, as, for example, when a child, imitating the clown in a pantomime, turns head over heels, or when a boy is taken up by the arms and swung round by a man on to his back in play. The latter occurred to a boy who was for several years under the writer's care; the immediate symptoms were not severe, and passed off in a short time, but disease of the spine was gradually developed, with external abscess, through which portions of necrosed bone came away; the boy ultimately recovered.

A fall out of bed has frequently been known to lay the foundation of spinal disease, and in many of these accidents there is no evidence of direct injury to the spine. In young adults, a rick or twist of the spine received in wrestling, and in the rough game of football, or by a fall from a horse, has been known to precede the development of disease without any direct blow upon the spine. In all these cases, the injury done to the articulation is in all probability by laceration of the ligaments, just as in severe sprains at the knee and ankle-joint; and when such an injury occurs in a person of markedly strumous constitution, the destructive inflammatory processes of ulceration and caries usually follow, as they do at other articulations, when local and constitutional causes are combined.

When of *constitutional origin*, disease of the spine is generally developed in children in whom we have sufficient evidence of a strumous constitutional condition, frequently associated with a consumptive family history; still cases are often met with where we have no such indications, but in which the disease has been developed during a condition of induced constitutional debility, that is, after an attack of scarlet fever, measles, or whooping-cough. In this class of cases we have the absence of any history of a local injury, either direct or indirect, and the disease appears to depend essentially upon the constitutional condition of the patient.

Symptoms and Diagnosis. — (1) **Early stage.**—During the early stage of Pott's disease of the spine, that is, before the production of angular curvature—a stage which usually occupies a period of from six to nine months—the symptoms are often so ill-defined that an accurate diagnosis cannot be formed. Two symptoms, namely, pain on motion, and pain on percussion over the spinous processes, have been too generally relied upon as indicating the existence of disease; but both these symptoms are frequently absent when disease exists, and are also present in an exaggerated form when there is no disease, so that their diagnostic importance is uncertain. Still, when present in conjunction with other symptoms, they are often of material diagnostic value. A certain amount of fixity in a portion of the spinal column, that is, a want of flexibility in the stooping position, is of importance as showing a condition of reflex muscular contraction, similar to that which exists at the hip and knee joints, in the early stage of disease.

There are some *regional peculiarities* of importance in reference to diagnostic symptoms; and the special symptoms present, with more or less distinctness in different regions, may be grouped in two classes, namely:—

(*a*) Pain occasioned by certain movements in which particular muscles, attached to the vertebræ which are the seat of disease, are called into play; and pain occasioned by percussion over one or more spinous processes.

(*b*) Attitudes assumed by the patient to avoid pain on motion.

In the *upper cervical region*, a constrained and fixed position of the head, to avoid pain on motion, always exists in the early stage of spinal disease; and the child finding a difficulty in keeping the head in the erect position, acquires the habit of supporting the chin by the hands, the elbows frequently resting on a table or chair. This attitude is of great diagnostic value. Occasionally in this region the disease is ushered in by obscure cerebral symptoms, resembling those of subacute meningitis.

In the *lower cervical* and *upper dorsal regions* there are no very distinctive symptoms, but in children there is not infrequently a troublesome cough, sometimes supposed to be a mild form of whooping-cough, probably depending upon irritation of the recurrent laryngeal nerve.

In the *middle dorsal region* the absence of symptoms in the early stages of Pott's disease is most marked, probably from the comparative immobility of this portion of the spinal column, motion in any direction being very limited; and probably also from the absence of any muscular attachments to the bodies of the vertebræ. Local pain, and pain on percussion, are sometimes present. The patient moves about slowly and cautiously, and generally sits with the arms extended, the hands resting on the chair, to relieve the spine of the superincumbent weight and the effect of pressure at the seat of disease, as well as to assist in breathing.

In the *lower dorsal* and *upper lumbar regions* the early stage of the disease is characterised by pain experienced in the various movements in which the psoas muscles are brought into play, such as the stooping position, putting on stockings, lacing boots, or lifting even a light weight from the ground; the act of going up and down stairs; any attempt to rise suddenly from the horizontal to the sitting or standing position, especially in the morning after a night's rest; any attempt to twist the body round suddenly when lying down, as in the act of turning suddenly from the back to the abdomen. In this region also may be mentioned as a diagnostic symptom the attitude assumed by the patient in the sitting position, as described when disease exists in the middle dorsal region.

(2) **Advanced stage.**—In the second stage of Pott's disease, that is, when angular curvature is developed, any previous difficulties of diagnosis which may have existed are cleared away, and we know the disease

has existed probably from six to nine months, and that a loss of substance in the intervertebral cartilage and bone has occurred. But exceptional cases, in which diagnosis may be doubtful, occasionally occur in two situations, namely, when a posterior projection of the spinous processes takes place, either of the seventh cervical and first dorsal vertebræ, or of the eight or ninth dorsal vertebræ—situations in which it may be said that a spurious form of angular curvature may exist, as an exaggerated condition of the naturally prominent spinous processes existing in these situations. The projection of the spinous processes, when occurring in the lower cervical and upper dorsal region, may be accompanied with such symptoms as local pain on pressure or percussion, and pain extending along the shoulders and down the arms, leading to the suspicion of the existence of disease. When occurring in the lower dorsal region, as it more frequently does in girls, the symptoms in these cases are generally due to muscular debility and hysteria; but as in some cases disease is subsequently developed, the diagnosis should be cautiously given, and any treatment based upon it cautiously followed out. The projection of the spinous processes of the seventh cervical and first dorsal vertebræ may often be traced to a natural conformation and family peculiarity, as we see in some short-necked and round-shouldered persons. This condition often occurs, in a more marked degree, in adults, and is increased by a thickening and hypertrophied condition of the cellular tissue, possibly also by fluid in a bursa; in such cases the neuralgic pains which accompany it are due to a gouty or rheumatic-gouty tendency.

Course, Duration, and Terminations.—The progress of Pott's disease of the spine is extremely variable, but as a general rule, within a period of from six to nine months from the commencement, angular curvature is produced. If the case proceed favourably, without external abscess or paralysis, the disease becomes arrested, and bony ankylosis takes place in about three years. When abscess and paralysis occur, the period of recovery is frequently prolonged to five or seven years. Paralysis from Pott's disease is fully described in another article (*see* Spinal Cord, Special Diseases of: 4. Slow Compression). The subject of psoas and lumbar abscess will be found treated of elsewhere. *See* Lumbar Abscess; and Psoas Abscess.

Recovery from the incomplete form of paralysis which occurs in these cases usually takes place in about two years. When the disease does not terminate favourably in bony ankylosis, death occurs; usually preceded by abscess, paralysis with meningitis, and inflammatory softening of the cord. In children the mortality is probably about one in twenty, and in adults about one in five cases.

Prognosis. — The prognosis in Pott's disease of the spine will be much more favourable in children than in adults, but in both it will be unfavourable in proportion to the rapidity with which the disease pursues its course, and also in proportion to the evidence of a strumous or tubercular diathesis.

Treatment. — The treatment of this disease must be both *constitutional* and *local.* The *constitutional* treatment is of importance. Evidence of a strumous or tubercular diathesis indicates sea-air, abundant feeding, and the exhibition of cod-liver oil with hypophosphite of calcium, iron, and other drugs of the same class.

The *local* treatment, especially, varies very much according to the age of the patient, and the region in which the disease is seated, the principles being essentially recumbency, counter-irritation, and mechanical support. With regard to the local treatment in the *first stage*, absolute recumbency should be insisted upon; and counter-irritation in some form or other, such as by blisters, the actual cautery, issues, or moxas, is also generally useful. Mechanical support to the spine in any form is not indicated in this stage.

In the *second stage* of the disease, that is, when angular curvature has taken place, absolute recumbency should still be insisted upon, for a period of from one to two years at least from the probable date of the commencement of the disease. This is more especially necessary when disease occurs in the cervical or upper dorsal regions, as not only is there a greater tendency to paralysis, and danger to life in this situation; but when disease takes place in the upper and middle dorsal region, and recumbency is not carried out, the ultimate deformity is always much greater than it need be. Absolute recumbency contributes not only to the arrest of disease, but to a diminution of the ultimate deformity.

When this disease occurs in infancy, or in young children, in any region, absolute recumbency must be insisted upon, the child living and being carried about in a spinal tray made of basket-work with a mattress inside. This may be necessary for three or four years. When disease occurs in the cervical or upper dorsal region, extension by the head may be combined with absolute recumbency; and this was first introduced by Mr. Fisher, who used a rack-and-pinion extension movement. The writer has adopted this principle with great advantage in a case of cervical caries, with partial paralysis, but he at first employed the weight and pulley attached to the upper extremity of the plane on which the patient was kept day and night. In other cases the writer has employed extension for the head by a rack-and-pinion movement, attached to a movable couch, so that the child can be placed in a spinal carriage and kept in the open air as much as possible. This must be continued for periods varying from two to four years, with the result of complete recovery from the paralysis, with very slight deformity.

As the case improves, in the course of one or two years, partial recumbency, with mechanical support, that is, recumbency for about half the day, may be substituted for absolute recumbency, and this is especially applicable to cases of disease occurring in the middle and lower dorsal regions, when the disease is not extensive, and appears to be running a slow or chronic and favourable course. As to the kind of support, a piece of thick gutta-percha applied and moulded to the back, whilst the child is lying on the abdomen, and retained by a bandage passed round the body, answers very well for hospital practice. A better kind of support is made of thick leather, blocked on a plaster-of-Paris cast of the back, with elastic in front. The plaster-of-Paris jacket applied during suspension, introduced into this country by Professor Lewis Sayre, of New York, in 1877, is very useful, especially in out-patient practice, where any rules laid down are certain to be disregarded. The principle of applying a form of support to the spine during the progress of disease, whilst the patient is suspended by the head, is novel, and has been very useful, but must be employed with caution. It secures immobility, relieves undue pressure, and diminishes the consecutive or compensating curves, in many cases to a greater extent than can be accomplished by horizontal extension; and plaster of Paris is a very useful material for the purpose, easily obtained, and can be applied by any surgeon. The disadvantages of not being able to remove it for washing purposes, and the liability to the production of sores from pressure and friction, which at first existed, have now been removed by Professor Sayre's improvement in making the jacket to open in front, and fasten by lacing. The material which has now to a great extent superseded the plaster of Paris is the poroplastic felt, which is applied when softened by steam, either when the patient is lying down, or suspended, according to the case; and which, being buckled on in front, can be removed as often as required.

Partial recumbency with mechanical support, in some modified form, must be continued in all cases occurring in childhood long after disease has ceased; and in some cases, in which the resulting deformity threatens to be considerable, even until the completion of growth.

2. Lateral Curvature of the Spine.—SYNON.: Skoliosis.

DEFINITION.—A deformity or contortion of the spine, in which the bodies of the vertebræ deviate laterally in a horizontal direction, with or without a corresponding deviation of the apices of the spinous processes.

ÆTIOLOGY.—The causes of lateral curvature are both *local* and *constitutional*; and as one or other of these causes may predominate, so the cases admit of being arranged in three classes: (1) Cases in which the constitutional largely predominate over the local causes. (2) Cases depending upon constitutional and local causes in about equal degree. (3) Cases essentially depending upon local causes acting mechanically, so as to disturb the equilibrium of the spinal column.

(1) In cases belonging to the first class the spinal curvature generally occurs under twelve years of age. Occasionally it is met with as a congenital affection. Many cases occur in infancy or early childhood, that is, under three or four years of age; but the majority between seven and ten years of age. When congenital, spinal curvature is sometimes associated with osseous malformation, but it also occurs without any such complication. The cases included in the first class can frequently be traced to an hereditary predisposition, lateral curvature occurring in two or three generations, and several members of the same family frequently being affected. The children usually exhibit signs of constitutional debility, and the local causes of curvature cannot be traced, except in infancy, when the children are nursed always on one arm.

(2) In the second class the spinal curvature generally occurs between the ages of twelve and sixteen. Hereditary tendency is not usually traceable. These cases may be arranged in two subdivisions—(*a*) *Cases depending upon induced constitutional or general debility, combined with local causes acting mechanically*; and (*b*) *those clearly of a rickety character.*

(*a*) The local causes are the long continuance of certain unfavourable postures or positions, such as standing on one leg; the sitting position, as in writing or drawing; sitting cross-legged; occupations which render the long continuance of some particular position necessary, such as needlework, book-folding, ironing, nursing children, and carrying heavy weights.

(*b*) The second series includes cases of lateral curvature of a rachitic character, associated with the general rachitic conformation of the skeleton.

(3) In the third class spinal curvature generally occurs previous to the completion of growth. These cases are essentially unconnected with any constitutional affection or hereditary predisposition, and frequently coexist with the natural amount of muscular strength. As local causes, in addition to habits and occupations above referred to, may

be mentioned the effects of a wooden leg, and inequality in the length of the legs from any cause, such as would disturb the equilibrium of the spinal column.

Anatomical Characters.—In the so-called lateral curvature of the spine, *the spinal column* does not yield in a purely lateral direction, as a flexible column would bend; but presents the appearance of a spiral twist, owing to the bodies of the vertebræ turning round in a direction of *horizontal rotation*, so that their anterior surfaces are directed laterally along the convexity of the curvature.

In a severe case this rotation commonly extends to a quarter of a circle in the centre of the curve, and diminishes from this point to the two extremities, so that the vertebræ, unequally turned upon themselves, cease to correspond in their natural relations to each other. This deviation of the bodies of the vertebræ does not necessarily correspond to, nor is it always indicated by, any lateral deviation of the apices of the spinous processes, although such deviation generally exists to some extent. In all cases, however, the internal deviation of the bodies of the vertebræ is much greater than the deviation externally of the apices of the spinous processes.

In all cases of confirmed lateral curvature, whether slight or severe, structural changes exist, varying in degree according to the severity and duration of the curvature. The structures affected are the intervertebral fibro-cartilages, the bodies of the vertebræ, and the oblique articulating processes. All these suffer simply from mechanical pressure, arising from the unequal distribution of the weight of the body. The fibro-cartilages and the bodies of the vertebræ suffer from unequal compression in the concavity of the curve, and become more or less wedge-shaped. The articular facets on the oblique articulating processes, which form the only direct articular connexions between the separate bones of the vertebral column, undergo important structural changes at an early period of the formation of lateral curvature, that is, as soon as it becomes confirmed. These articular facets become altered in their direction and aspects, according to the extent of the lateral deviation, or rotation, of the bodies of the vertebræ. In the lumbar region, where the articular facets are naturally nearly vertical in direction, looking inwards and outwards respectively, they gradually assume, in a severe case of lateral curvature, an oblique direction, looking obliquely upwards and downwards. Mr. Alexander Shaw first directed attention to these changes in the oblique articulating processes, which, as he observes, receive the weight of the body in the act of leaning to one side and are the only bony structures which check the lateral movements of the trunk; and when any such position is long persisted in, the articulating processes, which are soft and imperfectly formed at the age of puberty, become wasted by absorption, as the result of unequal pressure. The joints of the articulating processes being situated posteriorly as well as laterally, the spinal column cannot yield in their direction without wheeling partially round. Hence the rotation of the bodies of the vertebræ becomes confirmed, together with the other structural deviations described.

The ligamentous structures, including chiefly the short ligamentous bands passing between and connecting the bodies of the vertebræ and the invertebral cartilages, and also the short articular ligaments connected with the oblique articulating processes, become adapted to the alterations in the bones, and in the articulating surfaces. It is an error to assume that in confirmed curvature the ligaments are relaxed and elongated on one side, and contracted on the other, as generally described; although in the physiological condition described as 'weak spine,' with an inclination to lateral curvature, a condition of muscular debility and general ligamentous relaxation undoubtedly exists.

The muscles have not been shown to exhibit any structural changes in the early stage of lateral curvature of the spine, except in those rare instances in which the curvature depends upon partial paralysis. In the late stages, or in adult cases of long standing, the spinal muscles have been found much wasted, pale in colour, and in more or less advanced stages of fatty degeneration. In the early stages of curvature an increased prominence of the spinal muscles is observed on the convexity of the curve, whether in the dorsal or in the lumbar region; but this does not depend upon any spasmodic or active muscular contraction. The muscles are simply displaced, or pushed outwards, by the angles of the ribs in the dorsal region, and the transverse processes of the vertebræ in the lumbar region, which are thus displaced as a part of the rotation movement described.

Deformity of the Chest.—Other structural changes exist in the ribs, which become distorted and altered in shape, so as to lead to deformity of the chest, characterised by a prominence and flattening of the ribs, which become bent at their angles on the side of the convexity—usually on the right side—and a depression of the ribs on the side of the concavity.

Anteriorly, the symmetrical form of the chest is completely altered; the sternum becomes very oblique, its lower extremity projecting; and the cartilages of the ribs corresponding to the side of the concavity of the curve—usually the left—are prominent, and bent upon themselves. The oblique diameter of the chest, therefore, is increased, but its capacity is altogether diminished, causing considerable disturbance in the relative position of the heart and lungs, and giving rise to functional derangement of these organs.

The pelvis also becomes distorted in lateral curvature, but only in one class of cases, namely, those of rachitic origin, in which the evidence of general rickets is unmistakably present. In all other cases of lateral curvature of the spine, the pelvis is of its full natural size, and well-formed.

Symptoms and Diagnosis.—Lateral curvature of the spine is generally supposed to be indicated by a lateral deviation of the apices of the spinous processes, but such deviation may exist either as a functional or as a structural condition. It may be seen in a case of weak spine with muscular debility and ligamentous relaxation, such as is frequently met with in quickly growing girls; or it may co-exist with rotation of the bodies of the vertebræ in confirmed lateral curvature. The evidence of rotation of the bodies of the vertebræ precedes the lateral deviation of the apices of the spinous processes in many cases, whilst in others the two conditions co-exist, and appear to take place simultaneously; but rotation of the bodies of the vertebræ may proceed to a considerable extent, the bodies moving horizontally through a quarter of a circle, with only very slight deviation laterally of the apices of the spinous processes. It is therefore the evidence of rotation we must look for in cases of commencing structural curvature, and not the lateral deviation of the apices of the spinous processes. Rotation of the bodies of the vertebræ is always evidenced by a posterior projection of the angles of the ribs on the one side, and depression on the other, in the dorsal region; and a corresponding posterior projection of the transverse processes of the vertebræ on the one side, and depression on the other, in the lumbar region. By these conditions alone can the existence of rotation of the bodies of the vertebræ be determined.

Course, Duration, and Terminations.—The progress of lateral curvature is extremely variable, tending naturally towards a process of spontaneous arrest in some cases, and in others to a progressive increase, with proportionate deformity. The course depends very much upon the form and situation of the curvature, especially whether it assumes the character of the so-called 'single' or of the 'double' curve; descriptive terms which, though not anatomically accurate, are sufficiently so for practical purposes. The cases which naturally lead to spontaneous arrest are those in which a double curvature exists, the one in the dorsal, the other in the dorso-lumbar region, the two curves being about equal in length; whilst the cases in which a progressive increase of curvature and deformity is certain to occur, are examples of the so-called long single curve, frequently involving the whole of the dorsal, together with a portion of the lumbar region, or the whole of the lumbar and a considerable portion of the dorsal region. In cases of double curvature with a marked irregularity in the length of the curves, increase will also certainly occur, but to a less extent than in the long single curves. The duration and terminations of lateral curvature have already been indicated.

Prognosis.—The prognosis will be unfavourable in proportion to the early age at which the spinal curvature commences, and the evidence of constitutional causes with hereditary tendency; and also in proportion to the inequality in the length of the curves, when double, or in cases of so-called long single curves. The prognosis will be favourable in proportion to the absence of these conditions.

Treatment.—For therapeutical purposes all cases of lateral curvature of the spine may be arranged in three classes: (1) *physiological curves*; (2) *commencing structural curves*; and (3) *confirmed structural curves.*

(1) With regard to the treatment of cases in the first class, *physiological curves*, no mechanical treatment by any form of spinal support should be employed, but reliance placed entirely upon physiological means, such as gymnastic exercises, partial recumbency, and attention to the general health. In some cases an elastic brace attached to stays may be of use.

(2) The second class, *commencing structural curves*, form the only curable cases of lateral curvature, and in their treatment the writer recommends a combination of mechanical support, gymnastic exercises, and partial recumbency. By this combination of physiological and mechanical means, the further progress of curvature will be arrested, and the best opportunity afforded for recovery from such slight structural damage as may have already occurred.

(3) In the third class, *confirmed structural curves*, mechanical support of some kind must be resorted to, and continued during the period of growth, with the hope of preventing increase, and obtaining some improvement in the curvature; but confirmed lateral curvature, whether slight or severe, with its adapted series of structural changes, is essentially an incurable affection. The most efficient retentive spinal support is that form of instrument made with a pelvic belt, and spring plates attached to vertical bars at the back, without any mechanism requiring alteration by the surgeon. In some favourable cases, the stronger spinal instrument, with steel plates attached to levers, and adjusted by rack-and-pinion movements, may be used with advantage. Sayre's plaster-of-Paris

jacket has been largely employed in these cases; but, from what the writer has observed in the practice of others, he disapproves of its application, on the following grounds: That it fails as a curative agent, the gain in height by extension being quickly lost; that it weakens the spinal muscles by its constant use, and hinders gymnastic exercises; that it restrains respiratory movements, and prevents active exercise. These disadvantages have, however, been diminished by the improvement of making the jacket to open in front. Another form of support now in common use is the poroplastic jacket, which when softened by steam is applied in the same way as the plaster-of-Paris jacket during suspension, but is free from the disadvantages of the latter, while it can be removed at any time for the purpose of gymnastic exercises. It acts as an efficient and light retentive support in many cases of incurable curvature. In this class of cases mechanical support, in whatever form it may be employed, must be combined with partial recumbency and gymnastic exercises during the period of growth; but after this period little good will be derived, except from mechanical support, when a disposition to increase of curvature exists. When there appears to be no disposition to increase of curvature, all mechanical support should be discontinued, attention being paid only to the general health.

William Adams.

SPIRILLUM (dim. of *spira*, a twist, a curl).—*See* Micro-organisms.

SPIROCHÆTE. — *See* Micro-organisms.

SPIROMETER (*spiro*, I breathe; and *μέτρον*, a measure).—Synon.: Fr. *Spiromètre*; Ger. *Spirometer*.

Definition.—An instrument for measuring the vital capacity of the chest.

Description.—The object of the several instruments that have been designed for this purpose, is to measure the total amount of air expelled from the chest by the deepest expiration following upon the deepest inspiration.

All our knowledge of spirometry is derived from Dr. Hutchinson's exhaustive paper in the *Medico-Chirurgical Transactions* of 1846. The instrument designed by Hutchinson consisted of a mouth-piece and tube communicating with a gasometer of registered and graduated capacity, into which the patient breathed.

A very convenient and accurate spirometer has within the last few years been introduced by Mr. Lowne, which works on the principle of the anemometer. The advantage of this instrument is its portability.

Dr. Waldenburg describes and figures, at p. 202 of his work, *Die pneumatische Behandlung, &c.*, a spirometer identical in principle with Hutchinson's, but more elaborate, and capable of being employed for the purpose of inhalation of compressed or rarefied air.

Dr. Denison, of Denver, Colorado, advocates the use of a modification of Hutchinson's spirometer to test the vital capacity, in association with that of a manometer to test the elastic tension of the lungs, and urges their use especially in life assurance work, and as an aid to selection of suitable climates.

Results.—The chief results of Dr. Hutchinson's labours may be thus summarised. The vital capacity varies according to *height*, *weight*, *age*, and *disease*.

1. *Height.*—There is an increase of 8 cub. in. in vital capacity for every inch in height between 5 ft. and 6 ft. Thus the vital capacity of a healthy person at 5 ft. to 5 ft. 1 in. being 174 cub. in., at 5 ft. 4 in. it would be 174 + 32 = 206 cub. in.; at 5 ft. 8 in., 238; &c.

2. *Weight.* — Excess in body-weight is associated with diminished capacity, in the proportion of about 1 cub. in. per lb. excess.

3. *Age.*—From thirty to sixty years the vital capacity decreases nearly 1½ cub. in. per year.

4. *Disease.*—The spirometer furnishes a very accurate standard of health or of the extent of disease, as regards the chest, the vital capacity in lung-disease diminishing from 10 to 70 per cent.

R. Douglas Powell.

SPITTING OF BLOOD.—A popular name for hæmoptysis. *See* Hæmoptysis.

SPLEEN, Diseases of.—Synon.: Fr. *Maladies de la Rate*; Ger. *Krankheiten der Milz*.

Introduction. — In the *Nomenclature of Diseases* published by the Royal College of Physicians of London, in 1885, the diseases of the spleen are classified under diseases of the lymphatic system. It is now generally admitted that the functions of the spleen are intimately connected with the work of sanguification, through certain special chemical processes (metabolic) giving rise to an assemblage of transformations of proteids, associated in some way, still unknown, with the metamorphoses of the blood-corpuscles. The spleen is most probably one of the seats of formation of the white blood-corpuscles, and of destruction of the red. It contains more *iron* than corresponds to the amount of blood present in it; and its juice contains salts similar to those which occur in the red blood-corpuscles. In pernicious anæmia there is evidence of blood-destruction in the spleen (*see* ANÆMIA, PERNICIOUS). In July 1889, Sir Spencer Wells published a case of successful splenotomy, the hypertrophied spleen weighing over 4 lbs. The interest of this case is enhanced by a report of an examination of the blood of the patient made by Dr. Dreschfeld one year after the operation, when, as in similar cases reported by Credé and others, the blood appeared microscopically to be quite normal. The red corpuscles were of normal size and appearance, and the leucocytes were present in normal proportion.

The most important indications of splenic disease are derived from the constitutional state due to extreme anæmia. This anæmia is characterised by the mucous membranes appearing pale and bloodless, the complexion and general surface waxy, earthy-like, or sallow; there is great debility and gradual wasting, characteristic dyspnœa, a tendency to hæmorrhages, general anasarca and dropsy—phenomena which are due to the poverty of the blood, justly referable to some morbid condition of the spleen, and now generally recognised by the name of *splenic cachexia*.

Another important function of the spleen, in connexion with the other ductless glands, ought not to be lost sight of in the study of its diseases, namely, that it acts as a diverticulum for the accommodation of a relatively large quantity of the blood, upon which those active metabolic processes take place which constitute a special function of the spleen. Its anatomical structure eminently fits it for this. After every meal it is in a state of more or less congestion or hyperæmia, which reaches its maximum about five hours after the taking of food; and it then returns to its normal bulk. Its yielding capsule and its veins, remarkable for their large calibre and great distensibility, even when the distending force is small, sufficiently explain the rapid physiological and morbid congestions with which the organ is affected, as well as the rapid subsidence of splenic enlargements. The ductless glands, and especially the spleen, vary so much in magnitude within healthy limits, that it is difficult to state their usual weight and dimensions. The spleen may, however, be stated to range in weight in the adult from four to ten ounces avoirdupois; but in cases of enlargement weights as high as 18 lbs., 20 lbs., and even 40 lbs., are on record. In atrophic states the writers have weighed it as low as half an ounce. In relation to the body its normal weight is about 1 to 350 or 400 up to the age of forty; and as age advances, the relation becomes as 1 to about 700. It usually measures about 5 inches in length; 3½ inches from the front to the posterior edge; and 1½ inch in thickness. Its bulk averages from 9¾ to 15 cubic inches; and its specific weight is about 1·060.

In the following paragraphs the diseases of the spleen will be shortly noticed, mainly in the order in which they are specified in the *Nomenclature* of the Royal College of Physicians of London—namely: (1) Acute Inflammation; (2) Enlargement; (3) Lardaceous Disease; (4) Cancer; and (5) Rare Diseases.

1. **Acute Inflammation.** — SYNON.: *Splenitis.*

ÆTIOLOGY AND ANATOMICAL CHARACTERS. As a *primary* affection, acute inflammation of the spleen is of rare occurrence in this country. It has been known, however, to result from blows, or other kinds of accidental violence; but such injuries are more apt to cause rupture of the organ. It is mainly to the occurrence of hæmorrhagic infarctions that splenitis, with more or less consecutive suppuration, is due. These infarctions occur during the course of infectious fevers; in blood-poisoning, such as pyæmia; and in valvular diseases of the heart, where vegetations of fibrin form on the valves, leading to ulcerative endocarditis, to embolism, or to both. Such infarctions are generally well-defined, more or less rounded masses when limited and in the substance of the organ, but generally wedge-shaped when involving larger portions. The base of the wedge is towards the periphery, where it may cause an elevation of the capsule, the apex being directed towards the hilus of the spleen. The infarctions vary in size from a pea to a hen's egg; and are at first of a dark brown or brownish-red colour, and quite hard. Colour, however, is soon lost, and they become yellowish-white. A margin of acute inflammatory reaction is often well-marked round their boundaries. Under such circumstances the spleen is enlarged, and of a deep purple colour; its tissue so soft as to be easily broken down—about the consistence of coagulated blood. Pus may form, generally in one or more abscesses of variable size; or the whole spleen may be converted into a bag of pus.

Suppurative splenitis has been seen under three forms: (1) As a diffuse infiltration—a splenic gangrene. (2) Cases in which one or more large abscesses are found in the splenic pulp—the result of injury (such as fractured rib); or phlebitis of the splenic vein—from purulent infection, enteric, or other acute febrile affections. (3) Metastatic abscesses from septicæmia, puerperal fever, or ulcerative endocarditis. These are generally situated towards the periphery of the spleen. Splenic abscesses have been known to open externally, into the left thoracic cavity, the stomach, the transverse colon, and the cavity of the peritoneum, where circumscribed peritonitis generally forms a limiting sac for the pus.

Splenitis may also terminate by the infarction caseating, or becoming a mass of fibrocellular substance, which, gradually shrinking up, leaves a cicatrix-like contraction on the capsular surface, in which calcification may occur. These infarctions in the spleen correspond to the areas which mark the terminal divisions of the branches of the splenic arteries, the change commencing beyond where the vessels break up into the hair-pencil-like small twigs known as *penicilli.*

Secondary splenitis is generally the result of pyæmia, or blood-poisoning, ending in abscess. Such pyæmic blocks or infarcts resemble the simple infarcts in shape, but they are more irregular, because the process tends to extend beyond the limits of the area of the terminal twigs of the blood-vessels; moreover, they rapidly proceed to suppuration, with inflammation of the superjacent capsule, this rapid progress and extension of inflammation being probably due to the very septic properties of the pyæmic infarct. In such cases there seems to be some spontaneous local coagulation of the blood in the splenic vessels—the blood itself being morbid, as in infectious fevers such as typhus—without any evidence of embolism.

Symptoms and Physical Signs. — The symptoms and physical signs of splenitis are mainly due to the presence of infarcts, and changes associated with them. The hyperæmia and inflammation cause the whole gland to swell. In cardiac diseases, with emboli from valvular vegetations, these infarcts are generally numerous, and the swelling is therefore proportionally great, with tumefaction and some pain in the left side; and probably there is ascites and dropsy. Such splenitis may go on even to suppuration, without marked local symptoms. The enlargement of the spleen—sometimes called ‘splenic tumour’—can generally be recognised by palpation, aided by percussion. Its form is that of the spleen exaggerated; and the lobulation or notching of its swollen anterior edge can sometimes be felt through the wall of the abdomen, if the patient be thin. The enlarged gland, growing, as it were, out from beneath the ribs on the left side, can sometimes be traced extending low down, as far as, and even into the pelvic region, well over beyond the right side of the *linea alba*, and backwards towards the spine, where its margin can be separated from the mass of the dorsal muscles. Its lower border can also generally be felt as a rounded edge. The tumour is movable in all directions by manipulation, by change of posture, and by the act of respiration, when adhesions do not fix it. Weight and uneasiness, rather than local soreness, are present. The splenic cachexia exists; and there may occur hæmorrhages from the stomach and bowels towards the fatal end of such cases, often so profuse as rapidly to hasten dissolution.

Diagnosis.—The diagnosis of enlarged spleen, resulting from splenitis due to one or other of the causes referred to, requires the exclusion of lardaceous disease; malignant or other tumours about the cardiac end of the stomach or tail of the pancreas; such swollen conditions of the spleen as exist in Hodgkin's disease; an enlarged left lobe of the liver; and renal, omental, and suprarenal growths.

2. **Enlargement.**—Ætiology and Anatomical Characters.—Simple enlargement of the spleen occurs under a great variety of circumstances; but true, uncomplicated *hypertrophy*, in its simplest form, in which nothing abnormal is to be seen in the spleen or in the blood, is a rare occurrence.

Enlargement with hyperæmia (*congestion* of the spleen) occurs as a result or concomitant of pyrexia in many specific fevers—notably in enteric and malarious fevers, erysipelas and puerperal fever, septicæmia, anthrax, and acute tuberculosis. The capsule of a spleen so enlarged appears very tense. The gland feels plump and elastic; but on section its substance is generally soft, pulpy, almost liquid, very full of blood, and of a dark colour. Sometimes, however, it is so firm that a more or less smooth or coarsely granular surface is shown on section, with an abundant new-formation of small lymph-cells and nuclei, many of them contained in large mother-cells (compound splenic corpuscles), and seen especially in the splenic pulp and vein. This condition constitutes the nearest approach to true hypertrophy, in which, with an increase in the quantity of diffuse granular matter, the enlargement is due less to hyperæmia simply than to increase of normal structural constituents. Thus the organ may attain two or three times its natural size; but the enlargement is only temporary, and subsides as the pyrexia subsides. An acute but temporary congestion is observed in many other infective diseases, such as the exanthemata, cholera, and erysipelas; and it is the first stage of most of the diseases of the spleen. It thus occurs in a number of morbid conditions, which differ widely from each other. This splenic congestion obviously affects the proper function of the spleen in relation to the destruction and formation of blood-corpuscles. In all the infective diseases the enlargement of the spleen seems to be intimately related to the presence in the blood of micro-organisms peculiar to these various diseases; and the blood, arrested for a time in the spleen, undergoes changes in its composition. The micro-organisms, being also arrested in the spleen, cause more or less marked disturbance there. Typical accumulation of micro-organisms in the spleen occurs in malarial fevers, in anthrax, and also in enteric fever. In malarial fevers, the various forms of the malaria parasite, together with its product—the characteristic black pigment — enclosed in leucocytes, abound in the spleen, and give rise to the pigmentation of the organ so constantly associated with these diseases. In anthrax, the blood-vessels, particularly the veins of the pulp, are filled with the *bacillus anthracis*, lying in the direction of the blood-current.

Simple enlargement sometimes results from long-continued *mechanical congestion*, following any obstruction to the portal circulation, or obstructive valvular disease of the heart. But cardiac diseases are less frequently the cause of splenic enlargements than are chronic diseases of the liver, and especially cirrhosis. In hepatic cirrhosis the spleen is generally double its normal size, with its capsule thickened and with numerous peritoneal growths on its surface—a perisplenitis — intimately related to the acute and subacute peritoneal inflammation so generally accompanying cirrhosis.

Chronic congestion of the spleen, especially in cirrhosis, ends in induration of splenic tissue.

Enteric fever is one of the infective diseases in which the spleen is always affected, when it may be found to be enlarged to more than double its normal size—an enlargement less marked in the adult than in children. It is then also less firm than in health, greatly infiltrated with blood, and the colour of its parenchyma is brown or pink. In extreme cases it may be almost diffluent, and between the tenth and fifteenth day it is always soft and granular, when tumefied lymph-cells, often multinucleated, and containing one to eight or ten red blood-corpuscles, may be counted in a single protoplasmic lymph-mass. Towards the end of the fever the spleen again diminishes; its parenchyma becomes less rich in blood; the lymph-cells contain fat-granules, with red pigment; and pigment-granules are found free in its pulp. As in malaria and anthrax, so in enteric fever the specific organism tends to accumulate in the spleen. In a considerable number of cases rupture of the spleen has been found in enteric fever. Hence the necessity of great caution in percussion over the spleen, and manipulation of the abdomen over this organ, in such patients.

The enlargement consequent on *malaria* is fully described in another article. *See* MALARIA.

There only remain to be noticed two special forms of splenic enlargement—one classified by the College of Physicians as a sub-variety, namely, *leucocythæmia* or *leukæmia*; the other a peculiar enlargement originally described by Dr. Hodgkin—*lymphadenoma*. *See* LEUCOCYTHÆMIA; and LYMPHADENOMA.

3. **Lardaceous Disease.**—Albuminoid disease is rarely limited to the spleen, but usually also affects the liver, kidneys, and sometimes the intestinal villi in the same patient. The trabecular interspaces, but more commonly the Malpighian sacculi, are filled with the new material, so that each corpuscle looks like a sago-grain. The spleen so affected is usually enlarged, and is specifically as well as absolutely heavier than in health. It tends to assume a globular form, with rounded, blunt, and thickened edges. While the central artery of the glomerulus may be intact, the walls of the arterioles and capillaries, and most of the elements of the splenic corpuscles, the lymph-cells, and the retiform tissue, are the sites of infiltration of the new amyloid material, which is readily stained of a reddish-violet colour with methyl-aniline violet, or of a mahogany-brown with a watery solution of iodine in iodide of potassium. *See* ALBUMINOID DISEASE.

A lardaceous spleen implies a long-standing cachexia, and in its most intense form is seen after protracted caries and necrosis of bone, especially when associated with scrofula or syphilis; or even after external injury which leads to protracted bone-disease. Hence the question is still undecided whether lardaceous disease arises from such local sources, or is a constitutional or general disease.

4. **Cancer.**—Cancer of the spleen is extremely rare as a primary lesion. It chiefly occurs as an infective process following cancer of the stomach or other viscus; or as generally disseminated encephaloid growths.

5. **Rare Diseases.**—Here it is only necessary to mention hydatid disease, tubercle, and the splenic enlargement occasionally occurring in congenital syphilis. Tubercle of the spleen is frequent in children, but rare in adults, and is usually in the form of miliary granules disseminated in the splenic pulp. It is always secondary to tubercle elsewhere, and commences in the reticulated tissue of the pulp. The centres of the nodules become caseous and the cells atrophy; while characteristic giant-cells may be found in the centres of tuberculous nodules. The bacilli of tuberculosis have also been demonstrated in the nodules by Ehrlich's method. In artificially produced tuberculosis in the guinea-pig and rabbit, by injection of tuberculous matter into the peritoneal cavity, the spleen (as in anthrax and enteric fevers) is almost always profoundly altered. It is enlarged and large quantities of bacilli accumulate in the nodules and in the cells of the splenic pulp.

TREATMENT.—Treatment of these diseases of the spleen by medicinal remedies is extremely uncertain, as can readily be understood from what is known of their pathology. All sources of mechanical congestion must, if possible, be removed or relieved. Saline purgation may be useful for this purpose; also compound jalap powder, with rhubarb and sulphate of iron, may be taken in such quantities as will produce three or four stools in the twenty-four hours. In employing measures of this description, regard must be had to the anæmia so usual in splenic disease, and care must be taken not to aggravate this by depletory means of too violent a character. Should abscess form and be considered surgically accessible, it must be opened and drained. The diagnosis of abscess of the spleen is by no means an easy matter, however, for rigors and other hectic symptoms have not always the same significance when they occur in connexion with splenic disease as in the case of most other organs. Nor, when in doubt, may we use the aspirator with the freedom we can employ in hepatic disease. In not a few instances fatal intraperitoneal effusion of blood has followed exploratory puncture of the spleen—a proceeding, therefore, which must not be lightly undertaken. The iodides and bromides of potassium have been recommended in splenic tumour. The biniodide of mercury, in the form of an ointment, rubbed into the skin so as to produce irritation, has also a reputation for reducing simple enlargement when not otherwise complicated. It is a question, however, if the same effect is not brought about by simpler counter-irritants, such as the liniment of iodine, which, while less troublesome to apply, expose the patient to no such risks as ptyalism or an aggravation by the mercurial of the anæmia so commonly associated with splenic disease. In the chronic enlargements of leucocythæmia and Hodgkin's disease, improvement of the general health is the most that can be permanently effected, by the employment of tonics, change of air, and attention to the hygiene of the patient. *See* Leucocythæmia; and Lymphadenoma.

William Aitken. Patrick Manson.

SPLENIC FEVER.—*See* Pustule, Malignant.

SPLENISATION.—A morbid state of the lung, in which it somewhat resembles the spleen in colour and consistence. *See* Lungs, Compression of.

SPORADIC (σπείρω, I scatter).—This term is used in connexion with diseases which occur occasionally, and in an isolated manner, amongst individuals; as distinguished from those which prevail endemically or epidemically. *See* Disease, Classification of.

SPORADIC CHOLERA.—*See* Choleraic Diarrhœa.

SPOTS.—A popular name for certain forms of eruption on the skin. *See* Eruption; Exanthema, Exanthemata; and Maculæ.

SPOTTED FEVER.—A popular name for typhus fever. *See* Typhus Fever.

SPRAYS, Therapeutical Uses of.—*See* Inhalations.

SPRUE.—*See* Psilosis.

SPUTUM.—Synon.: Fr. *Crachat*; Ger. *Auswurf; Sputum.*—This article deals with the diagnostic indications afforded by a microscopical examination of the sputum, and with the requisite methods of preparation. The pathological constituents of the sputum to which definite diagnostic importance can be attributed are comparatively few in number. These will be considered under the following heads: (1) Micro-organisms; (2) Elastic tissue; (3) Curschmann's spirals.

No special description will be devoted to the rare instances in which hooklets derived from hydatid cysts in the lung, or portions of laryngeal or pulmonary new-growths may be discovered in the expectoration, inasmuch as these structures require no special preparation for their identification.

1. Micro-organisms.—*Tubercle bacillus.* In order to detect the presence of this microbe, it is important to secure a suitable specimen of the sputum for examination. The morning expectoration, representing a gradual accumulation formed during the hours of sleep, is most likely to contain a mixture of the secretions of the respiratory tract, and is therefore most suitable for the purpose. Moreover, the sputum expelled at this time is less likely to be contaminated with particles of food. The expectoration, having been collected in a clean vessel containing no disinfectant solution, should be poured out into a flat glass dish in order to facilitate the preliminary examination. Search should be made for the yellowish streaks or specks which can generally be recognised even in sputa which seem to be purely mucous. Where the secretion is more or less opaque throughout, the thickest and most curly parts are to be selected. With the help of a scalpel, needle, platinum-wire, or, as Ehrlich suggests, a fine steel pen with one of the nibs broken off and fixed in an ordinary penholder, a very small portion of the sputum is transferred to a clean cover-glass, and another cover is placed on the first, the two slips being gently pressed together with a pair of forceps. By this means the sputum is distributed in a thin film on the two glasses. A difficulty sometimes occurs with very viscid gelatinous sputa, which resist all attempts to spread them out. In this case, the secretion on the cover-glass should be allowed to dry partially, when there will be no further difficulty in obtaining sufficiently thin and uniform layers on the two surfaces when the glasses are pressed together. The cover-glasses are now separated by a slight sliding movement, and allowed to dry thoroughly, after which they are passed rapidly face upwards three times through the flame of a spirit-lamp or Bunsen burner to coagulate the albumen. They are then ready for staining. The following reagents are required:—

A. A solution of fuchsine. Several different formulæ have been proposed, but either of the two following may be adopted:—

(1) Ehrlich's solution, consisting of 11 c.c. of a saturated alcoholic solution of fuchsine added to 100 c.c. of a saturated watery solution of aniline oil. This fluid is very unstable, and should be made freshly each time it is required. Small quantities may be prepared by pouring five or six drops of the alcoholic solution of fuchsine into a watch-glass full of aniline water.

(2) Ziehl's solution, or carbol fuchsine, consisting of 10 c.c. of a saturated alcoholic solution of fuchsine added to 90 c.c. of a 5 per cent. watery solution of carbolic acid. This solution has the advantage of being much more stable than the first, and may be preserved for several months.

B. A 25 per cent. solution of sulphuric acid.

C. A concentrated watery solution of methylene blue.

The staining fluids must be filtered each time they are used.

The cover-glasses on which the sputum has been dried are placed in some of the fuchsine solution (A) in a watch-glass or glass capsule, and the fluid is heated cautiously over a spirit-lamp or on a sand bath until bubbles begin to rise. The solution is then allowed to cool for two or three minutes, after which the cover-glasses are removed with forceps and dipped into some of the acid solution (B) for two or three seconds, and then quickly washed for about ten seconds in a fine stream of water flowing from a tap. The preparation has a deep red colour when removed from the fuchsine, but assumes a yellowish-grey appearance in the acid. When subsequently washed in water, the specimen again turns red. Next the cover-glass is stained with the blue dye (C) for about a minute, and again washed for five or six seconds in a stream of water. The excess of water is then drained away, and the cover-glass is allowed to dry. The process may be shortened by drying the cover-glass cautiously between two pieces of filter-paper. When the specimen is thoroughly dry, it is mounted in a drop of Canada balsam dissolved in benzol or xylol.

For the recognition of the tubercle bacilli, a magnifying power of 250 to 300 is sufficient in most cases, if the illumination be brilliant. Abbé's sub-stage condenser greatly facilitates the detection of the bacilli; and in all doubtful cases, where the microbes are scanty, the combination of Abbé's condenser with a one-twelfth oil-immersion lens is indispensable. With the method of staining above described, the bacilli appear as delicate crimson rods, in length from one-quarter to one-half the diameter of a human red blood-corpuscle. The rods may present a uniform bright red appearance, the staining may be unequal, or the microbes may present a beaded appearance resembling a string of red granules. The last result of staining has been attributed to the presence of spores in the bacillus. No clinical importance can be attributed to these morphological differences. Various other bacilli and micrococci contained in the sputum, as well as the nuclei of cells and filaments of mucin, take the blue stain, contrasting sharply with the red tubercle bacilli.

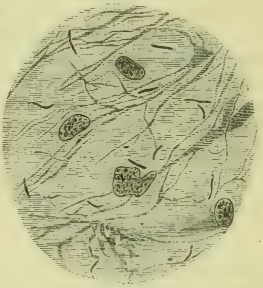

Fig. 158.—Tubercle Bacilli in Sputum. × 550.

The bacilli are seen as dark rods, lying amidst threads of mucus and a few pus-corpuscles.

The clinical recognition of the bacillus is based on the staining reactions involved in the foregoing process devised by Ehrlich. The bacillus of tuberculosis is distinguished from all others, with the exception of the leprosy bacillus, by the fact that it retains the stain of certain aniline dyes when exposed to the action of strong mineral acids, other bacilli becoming decolorised by this process.

The following is Ehrlich's explanation of the results of his method:—

In order to stain the tubercle bacillus successfully, a combination of a salt of aniline with aniline itself, or with phenol, is required. The double compound thus formed is an oily, comparatively insoluble, substance of a brilliant colour, which becomes deposited in the protoplasm of bacilli and cells generally. The tubercle bacillus takes up watery solutions of the aniline dyes with great difficulty, but is readily stained when certain of these dyes are combined with aniline or phenol. This peculiarity probably depends on the existence of a special sheath enclosing the bacillus. The sheath resists the passage of watery and acid solutions, but is readily permeated by oily substances like aniline or phenol, and by alkalis.

In Koch's original method, an alkaline solution of an aniline salt was employed to stain the bacilli.

Aniline, or phenol, therefore, has a twofold function: it combines with an aniline salt—fuchsine (hydrochlorate of rosaniline)—to form a pigment of extreme brilliancy; and at the same time it moistens or alters the bacillary sheath in some way so as to allow of the diffusion of the dye into the protoplasm of the bacillus, where it is deposited in fine particles. When the pigment is exposed to the action of a strong acid it becomes converted into a highly soluble but colourless tri-acid salt, in consequence of which the cells, mucin, &c., are decolorised; but, owing to the resistance offered by the sheath of the bacillus, the acid does not come into contact with the dye deposited in the substance of the microbe for some time, and the staining therefore remains. Prolonged exposure to the action of the acid results in decolorisation of the bacilli also; but for a certain period of time, which is liable to variation, the addition of water causes the red colour to reappear. This depends on the action of water decomposing the tri-acid salt into the mono-acid pigmented salt and free acid. Ehrlich supposes that the prolonged action of a strong acid on the delicate sheath so alters the latter that it permits the diffusion of the comparatively small molecule of mineral acid, but resists the passage of the highly complex and large molecule of rosaniline hydrochlorate. Thus the pigment is retained in the protoplasm of the bacillus.

Significance.—The discovery of tubercle bacilli in the sputum is a decisive proof of the existence of tubercular disease of some part of the respiratory system. In cases of tuberculosis of the air-passages, bacilli are discharged from the surface of the ulceration; but the number derived from this source is insignificant as compared with the quantities that come from cavities in the lungs. If we exclude the extremely rare cases of primary tubercular ulceration of the main air-passages, it may be affirmed that a large number of bacilli in the sputum is a certain sign of pulmonary excavation. The size of the cavity or cavities is immaterial, but free communication between a vomica and a bronchus is a necessary condition.

The number of the bacilli is no certain index of the severity or extent of the disease, and may be said to be largely a question of discharge. In some acute pneumonic forms of tuberculosis the microbes may for a time be very scanty, whereas in cases of the most chronic and limited disease the sputum may teem with tubercle bacilli. It has been asserted that where tubercular ulceration of the larynx exists the number of bacilli is always large. This statement is incorrect, as numerous observations have convinced the writer. Complete and permanent disappearance of the bacilli from the sputum is a most favourable sign; but, on the other hand, persistent expectoration of these micro-organisms is not incompatible with a favourable and chronic course of the disease.

Actinomycosis.—In the rare instances in which this disease attacks the respiratory system, the characteristic ray-shaped organisms may be discharged in the expectoration. These appear as minute yellowish granules visible to the naked eye in the purulent discharge. When a drop of the pus is examined without any staining, the rosettes of clubs can readily be recognised with a moderately high power. If dried cover-glass preparations be stained by Gram's method, combined with rubine or eosine as a counter-stain, the mycelial threads and clubs may be demonstrated. The presence of the ray fungus is pathognomonic of actinomycosis. *See* Actinomycosis.

Pneumonia.—Among the various microbes that may be found in the sputum of croupous pneumonia two varieties occur with great frequency, namely, short thick rods (Friedländer) and diplococci (Fränkel), both commonly provided with a definite capsule. Diplococci are far more often present than the rod-shaped forms. In dried cover-glass preparations these organisms may be stained by Gram's method, methylene blue, and other dyes.

Significance.—As similar microbes are sometimes met with in other diseases, such as bronchitis, and in healthy saliva, no definite diagnostic significance can at present be attributed to them. *See* Micro-organisms.

2. **Elastic Tissue.**—In destructive pulmonary disease of all kinds, portions of the elastic framework of the lungs are from time to time expectorated, and can be recognised with the microscope. In some cases the elastic tissue may be detected without any special preparation. The sputum is poured out into a flat glass dish, and some of the most opaque parts are selected and transferred to a glass slide; a cover-glass is then pressed lightly on the sputum, and the specimen can be at once examined.

But for general use Dr. Fenwick's solvent method is much more satisfactory. Equal quantities of the sputum and a solution of caustic soda (twenty grains to the ounce) are boiled for a few minutes until the mixture becomes liquefied. It is important not to continue the boiling too long, as the elastic fibres themselves ultimately become much altered in appearance. The fluid is now set aside for two to twelve hours in a tall conical glass, to allow the elastic tissue to sink to the bottom. A drop of the sediment is then withdrawn with a pipette, and examined with the microscope in the usual way. A magnifying power of 90 to 100 diameters is sufficient in most cases; but when the fibres are isolated or much broken up, a higher power may be required. In the latter case, difficulties are apt to arise from the fact that the sputum commonly contains adventitious fibres closely resembling elastic tissue. In some cases the curled-up ends and branching fibres may serve to distinguish the elastic tissue of the lung; but unless some trace of the characteristic alveolar arrangement be recognisable, it is unwise to hazard a positive diagnosis. *See* MICROSCOPE IN MEDICINE.

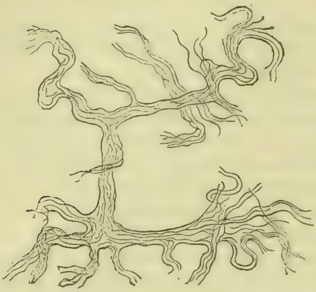

FIG. 159.—Elastic tissue of the lung in Sputum. × 550.

SIGNIFICANCE.—The discovery of elastic tissue in the expectoration may be regarded as definite evidence of destructive disease of some portion of the respiratory tract. With rare exceptions, the elastic fibres come from the lung, though at times they may be derived from the larynx or bronchi, in which case no alveolar grouping will be found. Tuberculosis, by far the commonest ulcerative disease of the lung, may generally be suspected when elastic tissue is found in the sputum; but in non-tubercular destructive affections the same discovery may be made. Hence elastic fibres do not possess the pathognomonic significance of the tubercle bacilli. In acutely progressing excavation, large groups of alveoli are often expectorated; whereas in cases of chronic disease the fibres are usually more isolated, and are not uncommonly encrusted with lime salts.

In the sputum of pulmonary gangrene the elastic fibres are generally scanty or ill-defined, and sometimes cannot be recognised at all. It has been suggested that this is due to the presence of a ferment in the gangrenous secretion, which dissolves the lung-tissue.

3. **Curschmann's Spirals.**—In the sputum expelled towards the close of an asthmatic attack, small gelatinous sago-like lumps of mucus are generally present. If these masses be gently pressed out between a cover-glass and a glass slide, certain spiral structures may commonly be recognised. The spirals vary much in size, often being visible to the naked eye, whereas at other times they can only be discovered with the help of the microscope. These structures consist of gelatinous threads of a mucoid substance, coiled in the form of a corkscrew. In many cases a central bright wavy or twisted thread occupies the hollow of the coil. v. Jaksch believes the central fibre to be chemically allied to fibrin, the spiral coil being composed of mucin.

SIGNIFICANCE.—These spirals are to be regarded as casts of the bronchioles. Curschmann considers that they are the result of an exudative bronchiolitis, and are causally related to the paroxysms of asthma. The spirals are not pathognomonic of asthma, as they are occasionally found in the sputum of bronchitis and croupous pneumonia. But, as v. Jaksch suggests, their presence in a case of asthma of doubtful nature would stamp the bronchial nature of the attack. Charcot-Leyden crystals (*see* MICROSCOPE IN MEDICINE) are often found adhering to the spirals, and sometimes seem to develop after the sputum has been allowed to stand for some hours. v. Jaksch believes that the crystals are products of chemical decomposition of mucin. PERCY KIDD.

SQUAMÆ (*squama*, a scale).—Scales. A synonym for scaly diseases of the skin. *See* PITYRIASIS RUBRA.

SQUINTING.—A popular name for strabismus. *See* STRABISMUS.

STADIUM (Lat., a stage).—A period or stage in a disease, as in fever; for example, *stadium incrementi*, *stadium convalescentiæ*.

STAGNATION OF BLOOD.—Local arrest of the circulation. *See* CIRCULATION, Disorders of; and INFLAMMATION.

STAINS.—This word, as applied to the skin, is synonymous with 'maculæ.' *See* MACULÆ.

STAMMERING.—SYNON.: Fr. *Bégaiement*; Ger. *Stottern.*

DEFINITION.—Under the head of stammering, in its broadest sense, are included many different forms of defective articulation, such as the inability, congenital or acquired, to pronounce certain letters or certain combinations of letters, the tendency to hesitate or stumble in utterance or to transpose letters or syllables, and the habit of interjecting meaningless sounds or words into the pauses which occur in the course of continuous speech. But the term is generally used, at any rate in English, as synonymous with *stuttering*, to imply a spasmodic affection of the organs concerned in speech, in virtue of which the enunciation of words becomes suddenly checked, and a painful pause ensues, not infrequently marked by a prolongation, or a repetition in rapid sequence, of the particular literal sound at which the check arises.

Ætiology.—Stammering is to some extent hereditary, although a large number of stammerers are certainly free from hereditary taint. It is sometimes imitative. The defect rarely, if ever, shows itself before the age of four or five years. Usually it comes on from this time up to the period of puberty; but it may originate at any age. Sometimes it occurs after febrile disorders; sometimes in connexion with nervous affections, such as epilepsy, hysteria, and tabes dorsalis; sometimes it attends mere temporary failure of health; sometimes it appears in connexion with soreness or irritation of the mouth; sometimes it is induced by simple nervousness or excitement. In many of these cases the stammering is temporary only, and disappears with its cause; and as a general rule confirmed stammerers have their infirmity aggravated under similar circumstances. Occasionally, on the other hand, stammering ceases during the presence of illness. It is a curious fact that men stammer in much larger proportion than women. Cases of persistent stammering, arising in childhood, sometimes recover in the course of time; and, as a general rule, some improvement takes place after the attainment of maturity, and especially as age advances.

Description.—It has often been maintained that stammering occurs only in connexion with the enunciation of the explosive consonants, that it never attends the utterance of the vowels, and that it never manifests itself during the acts of whispering and of singing. All these statements, however, though founded on fact, are more or less inaccurate. For though it is at the explosive consonants *b*, *p*, *d*, *t*, hard *g* and *k*, that stammerers for the most part come to grief, stammering is by no means uncommon during the articulation of the continuous consonants, such as *v*, *f*, *th*, *z*, *s*, *sh*, *y*, *w*, *m*, *n*, and even occurs when vowel-sounds are being produced; and though it is certainly rare for patients to stammer when whispering or singing, there are exceptions to this rule.

When stammering takes place in connexion with the explosive consonants, the barriers by the sudden opening of which after complete closure the several consonantal sounds are produced, instead of separating, as they should do, remain spasmodically closed; and the patient, struggling to overcome the spasm, either remains, for a variable but short time, absolutely voiceless, or, overcoming the resistance fitfully, utters the consonantal sound in a series of two or more successive puffs. In the utterance of *b* and *p* it is the lips which remain closed; in the utterance of *d* and *t* it is the barrier formed by the tongue, whose tip is pressed against the superior incisors or anterior part of the palate; in the production of hard *g* and *k* it is the barrier formed by the pressure of the dorsum or root of the tongue against the posterior part of the palate.

In pronouncing the continuous consonants, the barriers at which the distinctive sounds are produced are not in absolute or uniform contact; and the consonantal sounds are continued during the passage of air through the constricted oral channel or through the nose. When, therefore, stammering attends their pronunciation, it is not due to any spasmodic closure of the parts engaged, but rather to their fixation in the natural position they have assumed, and to the frequent association therewith of more or less rhythmical attempts to close them or to separate them more widely from one another. The resulting sounds therefore either come to a full stop, or are simply prolonged or drawled, or are repeated.

In the utterance of the vowels the mouth and its appendages play only a subordinate part, and a free passage is maintained for the passage of air through the mouth. It is at the rima glottidis that the fundamental sound is produced, and it is mainly to spasm of this part that vowel-stammering is due.

But the hitch in utterance may also originate in the respiratory apparatus, and not infrequently stammering depends on a sudden inspiration or expiration, or on an arrest of the respiratory movements.

It will thus be seen that stammering may be caused by spasm of either of the three mechanisms concerned in the mechanical production of speech, namely, the mouth, wherein words are articulated; the larynx, where phonation is effected; and the respiratory apparatus, which regulates the supply of air to the organs of speech and of music. At the same time there is no doubt that stammering is far more frequently connected with spasm of the muscles of articulation, than with spasm of the larynx or of the respiratory muscles, and that, of the three, respiratory spasm is the least common. Not infrequently, however, the different varieties of spasm are associated in a greater or less degree.

The degree and character of stammering differ largely in different cases. Sometimes it is nothing more than a scarcely perceptible hitch in the enunciation of a particular letter; sometimes it is so severe and continuous that the patient becomes almost unintelligible. The most distressing cases are those in which the spasm extends to parts unconnected with speech, it may be to nearly the whole muscular organism. In such a case the spasm commences, let us assume, at the base of the tongue; the mouth opens widely, and remains in that position; the muscles of expression work convulsively; the glottis contracts; respiration becomes arrested; the face becomes congested and the veins dilated; violent spasmodic movements involve the trunk and limbs; and only after some time, either when the patient becomes exhausted or resolutely restrains the attempts to articulate, does his paroxysm come to an end. A stammerer of this kind is a truly pitiable object. Fortunately for him, however, these severe paroxysms are not always present; they increase in number and intensity under excitement or nervousness; and, on the other hand, may be replaced to a large extent in ordinary quiet conversation by merely slight hitches or drawls or reduplications of letters. A condition allied to stammering, to which the name *Aphthongia* has been given by Fleury, has been occasionally observed. It seems to be the product of intense excitement, and of temporary duration only; and to be characterised by powerful spasm of the muscles supplied by the hypoglossal nerves, including the sterno-hyoid, sterno-thyroid, and thyro-hyoid muscles, which comes on whenever an attempt to speak is made, and totally prevents speech.

Pathology.—The pathological explanation of stammering is obscure. There is no reason to believe that it depends on any discoverable material lesion, either of the organs concerned in speech, or of the nervous mechanism which controls them. It appears to be allied to a series of spasmodic affections, which have been especially studied by Duchenne, in which complex coördinated movements (facility in the execution of which is only attained by long practice) are concerned; such, for example, as scrivener's palsy, and the recurrent spasms which occasionally compel the skilful pianist or violinist, or the practised swordsman, to give up his pastime or avocation. Speech is pre-eminently an art of this kind. It is slowly and laboriously learnt in early childhood; and ease and accuracy of articulation are the result only of long and continuous practice. We are born with the capacity for speech, but articulate speech itself is the outcome of careful education. For its successful performance it is necessary that three distinct and complex mechanisms—the respiratory, the phonetic, and the articulatory—shall act with precision and in exact concordance; that the lungs shall be expanded at suitable intervals, and to a suitable degree, and that the force of expiration shall be regulated with nicety; that the rima glottidis shall be opened or closed according as surd or sonant letters are to be produced, and that the tension of the cords shall be accurately adjusted to the pitch of the musical tones required to be produced; and that the movements of the lips, jaws, tongue, and soft palate shall be accurately adjustable for each literal sound, and capable of passing from one set of adjustments to another with rapidity and smoothness. Of all these coördinated movements, those connected with articulation are the most various in their grouping, the most rapid in their changes, and the latest learnt. It is natural, therefore, that the hitch or spasm interrupting speech should occur mainly in connexion with these, and mainly, if not exclusively, at the instant of passing from one literal sound to another; that is to say, at the moment of transition from one set of muscular combinations to another set. It is natural too that the laryngeal or the thoracic spasm should occur rather in association with articulation than at other times; inasmuch as the movements are more various and intricate during articulation than they are during ordinary respiration, or even than they are in the production of musical notes, as in singing. In the last case the laryngeal changes, though extremely delicate and exact, are mainly of one kind only, dependent, namely, on variations of tension in the vocal cords.

Treatment.—In dealing with cases of stammering it is necessary in the first place to counteract, or cure, if possible, any affection of the mouth or throat, or any general disorder that may be present, which are frequent causes of temporary stammering, or of aggravation of habitual stammering. Assuming, however, that the patient is in other respects in absolutely good health, what can be done? Many kinds of medical treatment have been practised, and even operative measures; but, as far as the writer knows, without beneficial result. The only methods, indeed, of any real efficacy are educational methods. The patient should be taught to practise slow and deliberate utterance, and, whenever the tendency to stammering occurs in connexion with any letter, to check himself momentarily by voluntary effort, and then to try again, rather than to struggle against his defect. He should, moreover, be taught to accustom himself so to regulate the admission of air into his chest during speech, that his utterance may never fail for want of breath. Further, considering that excitement and nervousness always aggravate stammering, he should learn, as far as possible, either to avoid speaking under these conditions, or to restrain excitement and nervousness, or so to control himself as to speak with special care and deliberation when he is thus affected. These measures should not only be observed in ordinary conversation, but be habitually and systematically practised in reading aloud; and especially those sounds, or those combinations of sounds, or those transitions from one sound to another, which are most difficult for him, should be made the subject of careful and constant study. By such means habitual stammering is sometimes cured, or, if not cured, so far kept in abeyance that an occasional momentary pause in speech is the only surviving indication of it that the practised ear can detect. More frequently, however, the stammerer remains a stammerer, either because he has never had the patience and determination which are necessary to carry out the line of treatment above indicated, or because his infirmity is one for which treatment is unavailing. By taking advantage of the well-known fact that stammering almost always disappears during singing, many stammerers have been able to counteract their defect by intoning. This method has proved of special efficacy in the cases of clergymen and other public speakers.

J. S. Bristowe.

STAPHYLOMA (σταφυλή, a bunch of grapes).—Synon.: Fr. *Staphylôme*; Ger. *Staphylom.*—This word was applied by old writers, in the jargon which was once supposed to be scientific, to any limited protrusion of the tunics of the eyeball. It was first used to denote the protrusion which occurs in the circumcorneal sclerotic zone, as a consequence of localised inflammation of this region. The tissue affected by the inflammation in such a case becomes softened, yields to the intra-ocular tension, and projects; but being restrained by bands of lymph, or by thicker portions of its own structure, from projecting uniformly, the prominence becomes more or less sacculated; and the most prominent portions, being thinner than the rest, and permitting the dark pigment of the interior of the eye to show through, present an appearance which may be compared to that of a miniature bunch of purple grapes—a real or fancied resemblance from which the term 'staphyloma' was derived. This form has more recently been termed *staphyloma of the sclerotic*, to distinguish it from *staphyloma of the cornea*, which is the protrusion left when the corneal tissue has been destroyed by ulceration, either wholly or in part, and the resulting cicatrix, formed of iris-tissue coated over by lymph, yields to the pressure of the fluids within the eye and becomes prominent. Corneal staphyloma is described either as partial or complete, according to the amount of cornea which is replaced by cicatrix.

Staphyloma posticum is a phrase applied to that protrusion of a circumscribed portion of the sclerotic, in the immediate vicinity of the optic nerve, which occurs in some cases of myopia; and which, by increasing the elongation of the eyeball, increases also the degree of the short sight. It would be highly desirable to abandon the term 'staphyloma' in favour of 'protrusion,' with such appended words as might serve to indicate the place and nature of the change. *See* Eye, and its Appendages, Diseases of.

R. Brudenell Carter.

STARVATION (Sax. *steorfan*, to perish).—This term is generally applied either to deprivation of food, or to the series of phenomena to which such want gives rise. The word is often used synonymously with *fasting*, which, however, may be more accurately applied to voluntary starvation. *See* Fasting.

STASIS (στάω, I stop).—Local arrest of the circulation. *See* Inflammation.

STATISTICS, MEDICAL.—This term signifies the collection of numbers respecting healthy and morbid processes, and respecting disease and death; the application of arithmetical and algebraical operations to such numbers; and the deduction of conclusions therefrom.

But little use of statistical methods was made in medicine before the present century; and much of the progress that science has recently made is largely to be ascribed to the direct use of such methods in pathology, ætiology, and therapeutics, and to the indirect influence they have had in promoting accuracy of thought.

The value of statistics depends upon the complete uniformity of the facts observed, and upon the accuracy with which the observations are made. It may be well here to remember the words of Rousseau, quoted by M. Louis: '*Je sais que la vérité est dans les choses et non dans mon esprit que les juge, et que moins que je mets du mien dans les jugements que j'en porte, plus je suis sûr d'approcher de la vérité.*'

In England much use of statistics has recently been made in the investigation of the causes of disease among communities. *See* Morbidity; Mortality; Periodicity in Disease; Public Health; and Vital Statistics.

G. B.

STEARRHŒA.—Synon.: Seborrhœa; Steatorrhœa; Fr. *Stéarrhée*; *Séborrhée*; Ger. *Talgdrüsenausschwitzung.*

Stearrhœa is an affection of the skin which is far from common in an idiopathic form, but often met with as an attendant on other skin-diseases, such as folliculitis, acne, gutta rosea, and lupus.

Description.—Two varieties of this disease are described: (1) *Stearrhœa sicca*; and (2) *Stearrhœa oleosa.*

1. *Stearrhœa sicca.*—This form is usually associated with folliculitis, and constitutes common pityriasis capitis, or dandriff of the scalp. A similar affection is often met with as a ringed eruption on the back between the shoulder-blades, and on a corresponding part of the chest. This eruption is a variety of follicular inflammation involving the sebaceous glands as well as the follicles, in which stearrhœa is a constant feature; it is very often associated with stearrhœa capitis,

so that it is impossible to dissociate the two diseases.

Stearrhœa sicca is usually met with on the scalp and eyebrows, and in adults is characterised by the formation of dirty-white or yellowish scales. The outermost of these become dry and fall off as a scurf. At the same time the hairs are shed, and those which replace them are imperfectly developed, so that partial baldness is caused. In uncomplicated stearrhœa there is no inflammation of the skin, and little itching; but it generally happens that the affection is associated with folliculitis, and then itching becomes a troublesome feature. This condition of the scalp is commonly known as *pityriasis capitis* or *alopecia furfuracea*, in which the skin becomes covered with great quantities of fine, pearly-white, glistening scales, which are constantly shed and fall upon the shoulders, giving the appearance of the hair having been powdered. There is, in fact, an excessive desquamation of cuticle; and when the hairs participate in the changes, as they often do, the vertex becomes bald. The degree of itching depends on the amount of folliculitis present. Stearrhœa capitis may be mistaken for dry eczema or psoriasis; but these diseases are rarely limited to the hairy part of the scalp, and the changes in the skin are much more marked.

2. *Stearrhœa oleosa.*—This variety of the disease is usually confined to the face, and is a very common complication of acne rosacea. It consists of an excessive secretion of sebum, which is changed in character into an oily fluid. This oil is poured out on the surface of the skin, and gives it a shiny appearance. When dabbed with a piece of blotting-paper, the fluid is absorbed and its greasy nature at once becomes evident. From the ready adhesion of dust, the skin assumes a dirty look which is very characteristic. This affection is especially prevalent in spirit-drinkers.

Treatment.—The treatment of stearrhœa is chiefly local, and consists, in the first instance, in removing any crusts which may have formed from the accumulation of sebum. These should first be softened by a thorough application of oil, and then well washed with hot water and soap. The subsequent treatment consists in the daily use of the white precipitate, or nitrate, or red oxide of mercury ointment, well diluted with vaseline. At the same time the skin should occasionally be washed with a lotion containing a little borax and ether. Before any local treatment is adopted, it should be carefully explained to patients that the process of rubbing off the crusts is always attended with the removal of a large number of loose hairs, otherwise they are apt to think that the loss of hair is caused by the treatment rather than by the disease.

Robert Liveing.

STEATOMA (*στέαρ*, fat; and the termination *oma*, adopted to indicate a tumour). Synon.: Fr. *Stéatome*; Ger. *Steatom.*—An atheromatous cyst. *See* Cysts.

STEATOZOON (*στέαρ*, fat or sebum; and *ζῶον*, an animal).—The names *Steatozoon* and *Entozoon folliculorum* were given by Erasmus Wilson to the microscopic animalcule called by Gustav Simon *Acarus folliculorum*, and by Owen *Demodex folliculorum*. *See* Acarus.

STENOSIS (*στενόω*, I constrict). — A constriction, narrowing, or stricture of an opening or a tube; for instance, *mitral* or *aortic stenosis*, in the heart; and *stenosis of the œsophagus*.

STERCORACEOUS (*stercus*, dung).—Fæcal; a term generally applied to vomited matter when it presents the characters of fæces. *See* Vomit: Examination of Vomited Matters.

STERILITY IN THE FEMALE. Synon.: Barrenness; Fr. *Stérilité*; Ger. *Unfruchtbarkeit.*

Definition.—Want of the power of reproduction in the female.

Frequency.—In the general community the proportion of childless marriages seems to be about 1 in 8 or 8·5; among members of the peerage 1 in 6·11. Whether Kehrer be correct in estimating that the husband is in fault in at least one-fourth of the cases of *sterilitas matrimonii* remains to be proved. Doubtless he is nearer the truth than those who attribute the sterility in nine cases out of ten to some fault in the wife, because whilst the comparatively rare cases of male impotence are readily enough recognised, and also the rarer cases of *aspermatism*, the cases of *azoöspermatism*, where an azoic semen is ejaculated, are for the most part altogether overlooked. The possibility that the cause of the childlessness may be found in the male must, therefore, always be borne in mind. But we confine ourselves here to the consideration of sterility in the female. *See* Impotency; and Sterility in the Male.

Ætiology.—For generation the essential product in the female is the ovum; and in her reproductive apparatus we find (i.) *oviparous organs* for its production; (ii.) *oviducts* for its transmission; (iii.) an *ovigerent organ* or nest in which the ovum is hatched; and (iv.) *copulative organs* for the reception of the semen, the spermatozoa of which constitute the essential contribution of the male. In a married woman in whom the generative function is in abeyance, the sterility may be either primitive or acquired. In the former case we have to do with a female who has never borne a child; in the latter the woman may have borne one or more children, but has for some years ceased to conceive. In either case we search for the fault in one or more of these four planes of her sexual apparatus.

I. **Faults in the Ovaries.**—The ova are developed in the ovaries, and the conditions which interfere with ovulation—that is, the regular ripening of an ovisac, and the discharge of an ovum—diminish or destroy the possibility of conception. Such conditions are found in:—

(1) *Absence* or *imperfect development.*—Cases of absence or defective development of the ovaries are rarely met with, except in women in whom the rest of the sexual apparatus is also anomalous.

(2) *Displacements.*—One or both ovaries may be found displaced. Instead of lying at the level of the pelvic brim, they have fallen into the pouch of Douglas. In this position, though the ripening and dehiscence of the ovisacs may be duly taking place, the discharged ova are not received into the free extremity of the Fallopian tube. The displaced ovary, moreover, is extremely likely to be the seat of some degree of inflammation.

(3) *Inflammation.*—Oophoritis, acute or chronic, lessens the conception-power in various ways. It may lead, first, to destruction of the follicles, so that no ova are produced; secondly, to condensation of the stroma, so that the regular ripening of the ovisacs is impeded; thirdly, to deposits on the surface, which prevent the dehiscence of the ovisacs; or, fourthly, to adhesions of the ovary in situations which hinder the entrance of the discharged ova into the oviducts.

(4) *Degenerations.*—The neoplastic degenerations to which the ovaries are most liable are the cystic; and all the varieties of cystomata, as well as the fibromata, the sarcomata, and the carcinomata, are commonly attended with sterility. Where both ovaries are affected the sterility is absolute, from the complete loss of function in the organs; and even where only one is affected, the disturbance in the relations of the pelvic organs, caused by the growing mass, is likely to prevent impregnation. *See* OVARIES, Diseases of.

II. **Faults in the Oviducts.**—The Fallopian tubes or oviducts serve not only for the reception of the discharged ova, and their transmission downwards to the uterus; they may serve also for the upward transit of the spermatozoa. Lawson Tait maintains that the entrance of spermatozoa into the tubes is pathological; but most authorities are of opinion that in them the male and female elements come into union.

(1) *Absence.*—Defective development of the Fallopian tubes is usually associated with other abnormalities of the sexual apparatus, especially with rudimentary conditions of the uterus.

(2) *Inflammation.*—Inflammatory changes may be found affecting either the external serous covering, or the internal mucous lining. In the former case sterility results from adhesions, which lead to displacements of the free extremities, so that they are not in a position to receive the ova discharged on the bursting of an ovisac; or from bands which constrict the tubes, and so occlude their canal. In the latter, changes in the secretion may prejudice the vitality of the spermatozoa or ova; or the thickenings, polypoidal or other, may obstruct the canal; or complete atresia may be produced, and their permeability be thus entirely lost. *See* FALLOPIAN TUBES, Diseases of.

(3) *Degenerations.*—The tubes are rarely enough the seat of neoplasms; but when such do develop in their walls, occlusion of their canal and consequent loss of function may ensue.

III. **Faults of the Uterus.**—In the process of reproduction, the uterus serves as the receptacle or nest, in which the fertilised ovum is carried during the period of incubation. In its proliferating mucous membrane the chorionic villi take root; through its expanded blood-vessels the fœtal blood is brought into relation with the maternal; its walls grow in correspondence with the increase in size of the ovum; and its largely developed muscular fibres are the main agents in the expulsion of the ovum when it is finally hatched. It plays such an important part in the female economy that the name of it is often used as synonymous with the sexual apparatus; and some of its morbid conditions are among the commonest causes of sterility.

(1) *Defective development.*—First, the uterus may be *absent* altogether, or represented merely by a fibrous nodule. Secondly, it may be *small*, having undergone arrest at some stage of its growth, and remaining infantile, juvenile, or adolescent. Thirdly, it may be *bicornuous*—retaining the trace of its original duplicity by the presence of a septum running through the body alone, or running through both body and cervix, perhaps through the vaginal canal as well. Fourthly, it may be *unicornuous*—only one of the halves of the organ having been developed, while the other tube may be obliterated, or attached as a rudimentary byhorn to the better-developed tube. Fifthly, a more frequent malformation is found in a *conical* form of the *cervix*, which is not infrequently complicated with, sixthly, *narrowness of the os.* This last condition may exist by itself, forming a well-recognised cause of sterility, and furnishing some of the cases in which a most satisfactory cure can be accomplished.

(2) *Displacements.*—First, *descent* of the uterus is found as the predominant morbid condition in some cases of acquired sterility, but this is more frequently associated with

the deviations anteriorly or posteriorly. Of these, secondly, the *antrorsions*, flexion and version, are very frequent among women who have never conceived at all; thirdly, the *retrorsions*, flexion and version, are more common in women who have given birth to one or more children, and have subsequently remained sterile. The flexions, in particular, form a very clearly recognisable and often remediable cause of sterility.

(3) *Changes in size.*—The retrogressive changes which occur in the uterus after labour sometimes go on morbidly, and in one group of cases leave the organ in a condition of, first, *super-involution.* The uterus may be reduced to a little tube which only admits the sound for half an inch. Even when the degree of super-involution is less, and the uterus still measures two and a quarter inches in length, it is apt to cause amenorrhœa and sterility. In another group of cases the uterus remains hypertrophied in a condition of, secondly, *sub-involution*, which is inimical to conception; and when conception does take place in such a uterus, abortion is liable to occur.

(4) *Inflammation.*—Among the commonest causes of sterility must be ranked the inflammatory changes to which the uterus is so liable, whether the process have affected mainly the external, middle, or internal coat: and in many of the cases where some other condition tending to sterility is present, inflammatory changes come in to increase the difficulty, and to cloud the prospects of recovery. First, *perimetritis* is usually only an element of a more general pelvic peritonitis, which often leaves behind it fixations and displacements of the uterus, preventing conception or promoting early abortion. Secondly, *mesometritis*, leading to thickening of the walls of the organ, produces an expansion of its cavity and disturbance of its function. It is rarely possible to dissociate this from, thirdly, *endometritis*, which is attended also with dilatation of the cavity, but which is further mischievous from the deleterious influence of its abnormal secretions on the life and progress of the spermatozoa, and from the difficulty with which a fertilised ovum gets healthily engrafted on its surface. Moreover, in certain cases of long standing, some of the uterine orifices may become more or less occluded, a result which is more especially apt to ensue in the external orifice when caustics have been applied to the cervical canal.

(5) *Degenerations.*—First, *myomata*, or fibroid tumours, are found in a considerable proportion of barren women. Whether subperitoneal, intra-mural, or sub-mucous, they interfere in many ways with conception, and give a proclivity to miscarriages or dangerous labours when conception has occurred. Secondly, *sarcomata* have usually their seat in the uterine cavity, and seem to be an absolute bar to impregnation. Thirdly, *carcinomata* have been sometimes met with in the pregnant uterus; but these are commonly seated in the cervix, and it is usually only in an early stage of the mischief that conception can occur. *See* Womb, Diseases of.

IV. Faults in the External Organs.—In various ways the organs which serve for the reception of the spermatic fluid may be so affected that their copulative function is disturbed or destroyed, and the patient remains sterile.

(1) *Malformations.*—Occlusions of the labia are rare; but the vaginal canal may be impervious, firstly, from abnormal conditions of the *hymen*; secondly, from *atresia* in some part of its course; or, thirdly, from complete *absence.* Even it will be found that in certain cases where the rest of the generative apparatus seems to be well-developed, a preternatural *shortness* of the canal is found in some sterile women, from whom the semen escapes immediately after it is thrown into the cavity.

(2) *Injuries.*—The injurious influences of a bad labour on the reproductive power of a woman may be found, first, in an undue *patency* of the canal, usually from extensive rupture of the perinæum; secondly, more frequently from *atresia*, partial or complete; or, thirdly, from *fistulous* formations, leading to communication with the neighbouring cavities.

(3) *Inflammation.*—In its acute stages, inflammation of the pudenda and vagina produces, first, *dyspareunia*; in its more chronic forms it may be productive of, secondly, *unhealthy discharges*, which endanger the vitality of the spermatozoa; or it may lead, thirdly, to *occlusions* of the labia, or of the vaginal orifice or canal. Partly of inflammatory origin is the condition, fourthly, of *vaginismus*, which is not an uncommon cause of impossible connexion.

(4) *Degenerations.*—The various neoplasms occur with rarity in the vaginal canal; but in the pudenda—sometimes from their bulk, sometimes from their sensitiveness—they interfere with connexion, as in cases of elephantiasis labiorum or of urethral caruncle. *See* Vagina, Diseases of.

Diagnosis and Prognosis.—Investigation into a case of sterility may require that we satisfy ourselves as to the fertilising powers of the male, and the due fulfilment of the marital function. Occasionally some concurrent disturbance in the functions of the sexual apparatus of the female, or of the neighbouring organs, may enable us to make a close guess at the cause of her barrenness; but we can only arrive at a true conclusion by a careful physical examination, having in view such a *vidimus* of causes as we have given. Some of the conditions, as, for example, the more pronounced malformations, or imperfect development, make us regard her as hopelessly sterile; others, such as uterine flexions and stenosis, some vaginal occlusions, and injuries and tenderness, we may undertake to treat with good hope of fruitful result.

Treatment.—In commencing the treatment of any case, we must bear in mind that morbid conditions may be present in more than one of the planes of the sexual system, and that we must begin with the removal of the obstacle that lies nearest the surface. Urethral caruncles and other sensitive structures in the vulva must be cut off or cauterised. Contractions of the vaginal orifice or canal must be stretched; and where there is complete atresia an aperture must be formed and kept patulous. Stenosis of the uterine orifices may be overcome by temporary dilatation with a tupelo-tent, which the writer has more than once seen followed by impregnation. Where such dilatation fails, the os may be dilated more permanently, by tearing it with an instrument like a pair of long dressing-forceps, the blades of which are forced apart after it has been passed into the cervix; or by dividing the cervix at both sides, or in one or other lip, with a hysterotome; or the orifice and canal may be dilated by means of graduated bougies. The deviations of the uterus must be rectified: versions, after replacement, being usually retained by some modification of Hodge's pessary, flexions demanding in addition the use of an intra-uterine stem. The stem-pessary of zinc and copper, introduced into the interior, is the best means of stimulating to its full function the imperfectly developed uterus, and the uterus which has withered from super-involution. Morbid conditions in the interior of the uterus require direct applications to its cavity. And as in a large proportion of the cases some inflammatory mischief complicates the other morbid condition, it is often helpful to the cure to make the patient use hot douches and baths, and the internal remedies which tend to remove the effects of inflammatory action. It is to the beneficial influence which the waters of Ems, Aix, Kissingen, and other spas exert on chronic metritis that their reputation for curing sterility is mainly due. In cases where the natural method of getting spermatozoa brought into relation with the ova has failed, success is said to have followed the introduction of seminal fluid by means of a fine syringe and tube into the cavity of the uterus—a line of treatment legitimate, it may be, but only to be adopted in quite exceptional circumstances.

Alexander Russell Simpson.

STERILITY IN THE MALE.—

Synon.: Fr. *Stérilité chez l'homme*; Ger. *Unfruchtbarkeit des Mannes*.—Sterility in the male has been confounded with impotence, no distinction having been drawn between inability to procreate and incapacity for sexual intercourse. A man may, however, be subject to *sterility*, independently of *impotence*. *See* Impotence.

Description.—Sterility may arise from the following causes: (1) Malposition of the testicles; (2) Obstruction in the excretory ducts of the testicle; (3) Impediments to the ejaculation of the seminal fluid; (4) Aspermatism or non-ejaculation; or (5) Azoöspermatism, or absence of spermatozoa from the seminal fluid.

1. *Malposition of the testicles.*—A testicle which does not pass into the scrotum is nearly always small in size, and often undeveloped, not having undergone the enlargement and change in structure which takes place at puberty. A testicle thus detained fails in some animals, as well as in man, to secrete a fertilising fluid; and a male with this defect on both sides, though often potent and efficient for sexual intercourse, is incapable of impregnating the female. Many striking cases illustrating this point have come under the notice of the writer, cases of persons with retained testes, who have married without their wives becoming pregnant, and in whom the fluid emitted in coition has been destitute of spermatozoa—*azoöspermatism*.[1] The facts which have been adduced as opposed to the conclusion that cryptorchics are sterile, are chiefly instances in which they are reputed to have procreated children; but it is remarkable that as yet no case has been found in which a retained testicle has been fully proved to be capable of secreting a fertilising fluid. Spermatozoa have been found absent in almost every case of retained testicle in which search has been made for them.

2. *Obstruction.*—The lymph exuded in the cavity and walls of the excretory duct of the testicle in epididymitis is liable to produce obstruction of the canal. This may be only temporary, the lymph becoming absorbed under treatment. Where the obstruction is complete and permanent, an induration is left in the tail of the epididymis; and when this exists on both sides, sterility is the result. Many curious cases of sterility from this cause have fallen under the writer's observation.[2] They show the great importance of steadily prolonging the treatment of epididymitis, until the enlargement and induration of the part have disappeared. The excretory duct of the testicle is liable also to be interrupted by tubercular deposits in the epididymis. Sterility from this cause in persons with double tubercular disease of the epididymis is not uncommon.

3. *Urethral impediments.*—A close stricture in the urethra so completely interrupts the passage of the seminal fluid, that in

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[1] For detailed evidence on this subject, see *Treatise on Diseases of the Testis*, by the late writer.

[2] Vide *lib. cit.*

ejaculation it regurgitates into the bladder, where it mixes with the urine. This is a condition which is remediable by the cure of the stricture.

4. *Aspermatism.* — Sterility sometimes arises from a cause which has been expressed by the term *aspermatism.* Thus, it is essential to the complete performance of the sexual act, that the local excitement should culminate in the reflex action of expelling the collected semen. Unless this takes place coition is unsatisfactory and fruitless. There are cases of men who never experience ejaculation, even after prolonged coitus, though they are subject to nocturnal emissions. This appears to arise in some instances from defective sensibility in the glans penis, which the writer has endeavoured to correct by the application of the acetum cantharidis to the glans, and by electro-magnetism. In one case of non-ejaculation, the nerves proceeding to the glans appear to have been destroyed by a syphilitic ulcer on the dorsum penis, or to have been compressed in its cicatrisation.

5. *Azoöspermatism.*—A few cases have been recorded of healthy, well-formed male adults, with ordinary sexual desires and sensations, capable of coition, and with seemingly normal ejaculations, who have proved sterile. Repeated microscopic examination of the semen has demonstrated the absence of spermatozoa. No explanation of this condition has as yet been discovered.

Conclusion. — The question may arise whether a man who has the inclination and power to copulate, but who is nevertheless sterile, is justified in contracting marriage. That a man who is unable to fulfil the command, 'to be fruitful and multiply,' is right in disappointing the hopes and perilling the happiness of a woman cannot, in the writer's opinion, be maintained; and he has felt it his duty to give advice in accordance with this opinion. T. Curling.

STERNUTATORIES (*sternuo*, I sneeze). Synon.: Errhines; Fr. *Sternutatoires*; Ger. *Niesmittel.*

Definition. — Remedies which cause sneezing, and produce an increased secretion from the mucous membrane of the nose.

Enumeration. — The principal sternutatories are Tobacco snuff, Veratrum album, Euphorbium, and Ipecacuanha.

Actions and Uses.—The action of these drugs is simply one of stimulation and irritation of the part to which they are applied; and the slight amount of gentle excitement furnished by snuff has ensured a wide popularity, although diminishing, for this preparation of tobacco.

White hellebore causes almost uncontrollable sneezing when incautiously inhaled, and powdered ipecacuanha-root is well known to cause excessive irritation in exceptional cases. No use is now made of these therapeutical actions, and it seems hardly necessary to retain the term 'sternutatories' any longer in our nomenclature. R. Farquharson.

STERTOR (*sterto*, I snore).—Synon.: Fr. *Sterteur*; *Ronflement*; Ger. *Schnarchen*; *Röcheln.*

Definition.—A term commonly applied to sounds in the throat resembling snoring, which occur in the apoplectic and like conditions. In this article the writer would extend the name to other sounds formed in any part of the respiratory passages or mouth by the movements of the air, under such circumstances.

Varieties.—Several varieties of stertor may be recognised, as follows:—

1. *Nasal.*—Nasal stertor arises from approximation of the alæ nasi towards the septum by the in-going air, as in the act of sniffing.

2. *Buccal.*—This form of stertor is due to vibrations of the lips, and puffings and flappings of the cheeks, during inspiration or expiration.

3. *Palatine.*—This arises from vibrations of the soft palate, whether the breath passes through the mouth or the nose.

4. *Pharyngeal.* — Pharyngeal stertor is caused by the lolling back of the base of the tongue into near contact with the posterior wall of the pharynx.

5. *Laryngeal.*—This variety is referable to vibrations of the chordæ vocales.

6. *Mucous.*—Mucous stertor is a term which may be given to the bubbling of air through mucus in the trachea or larger air-tubes.

Ætiology.—One or more of the varieties of stertor, in varying degrees of intensity, may occur in any of the following morbid conditions, namely: Suffocation; epilepsy; convulsions in children; the death-agony; fractures of the skull, and concussion of the brain; bronchitis—particularly in old subjects, sudden œdema of the lungs, and large hæmorrhages into the lungs; great exhaustion; chloroform-poisoning, drunkenness, and opium-poisoning; drowning, and all conditions in which mucus or other fluid is present in the lungs; and all forms of sopor, whether natural or the result of accident or disease.

Description.—The general phenomena of stertor are those of suffocation.

A patient may be found lying in a state of complete unconsciousness, with a congested, turgid, and expressionless face; usually dilated and fixed pupils; insensitive conjunctivæ; a hot and perspiring skin; throbbing arteries; a full and bounding pulse; and, lastly, noisy breathing, the direct result of mechanical interference with the passage of air into or out of the lungs, whether arising from contractions of the orifices, and vibrations of the soft parts of the nose, lips, cheeks, palate, pharynx, or larynx, or from mucus in the trachea and bronchial tubes. When the obstruction to the breathing is only slight, but long-continued, the face may be of a dusky pallor, and there is an entire absence of turgidity and congestion.

Pathology.—All the varieties of stertor, whether manifested singly or in combination, have been usually regarded, especially in the case of apoplexy, as symptoms essentially and mysteriously connected with the primary disease. This is not the true account of their pathology. Whatever may be the original cause, these symptoms only indicate a varying amount of obstruction to respiration, sometimes so great as to be fatal in itself, but only as a secondary and, so to speak, accidental consequence of the primary disorder. Stertor is, in fact, 'suffocation.' In its effects it may be compared with croup; and being equally dangerous, it may equally require relief. But even buccal stertor, which many authors have looked upon as of so grave importance, may not infrequently be observed in ordinary sleep; and the writer has seen recoveries from apoplexy, in which at different times all the forms of stertor have been present. Stertor in apoplexy being, then, apoplexy *plus* suffocation, the whole subject, as regards diagnosis, prognosis, and morbid anatomy, must be approached from a new point of view. The congested and turgid face, the noisy breathing, the *râles* in the chest, the throbbing arteries, and the full and bounding pulse, which are the generally received symptoms of sthenic apoplexy, and which have been regarded as indicating the adoption of venesection and active remedies, are neither more nor less than signs of suffocation. Immediately upon the removal of obstructions to the breathing, all these symptoms disappear, and with them the necessity for active treatment. Long ago Heberden and Fothergill questioned the propriety of bleeding in such cases, and the latter thought that these violent symptoms arose from an exertion of the *vires vitæ* to restore health; whereas they really indicate a struggle to overcome impediments to respiration and circulation. Directly these impediments are removed, all is quiet in apoplexy, and the practitioner is enabled to judge of the real state of the case—which side is paralysed, whether the nerves are losing or recovering their power, and what evidences exist as to greater or less interference with the functions of organic life.

Treatment.—In stertor, as in strangulation, we must proceed at once to remove the impediment to free respiration.

Nasal stertor.—This may be relieved by pressing upwards the tip of the nose, or by keeping the nares open by the handle of a common salt-spoon.

Laryngeal stertor.—In apoplexy this never appears dangerous enough to warrant tracheotomy, which alone would remove it.

Buccal, pharyngeal, palatine, and mucous stertor.—These varieties of stertor are readily treated by placing the patient comfortably on one side, and affording support by well-arranged pillows. In this position the buccal and palatine stertor, if any remain, will be too feeble an impediment to require further attention. The tongue drops to the side of the pharynx, and leaves plenty of room for the in-going air. The mucus or fluid, too, whether resulting from these or other forms of stertor, drains away into the lowermost lung, thus preventing the formation of large foam-vesicles in the trachea (the 'death-rattles'), which are always dangerous respiratory impediments. Care should be taken to keep the neck rather straight, as, if the chin be brought too near the sternum, the thyroid cartilage presses upwards and backwards, and pushes the base of the tongue towards the back of the pharynx. In the management of mucous stertor it must be observed that, after a time, varying from one day to three or four, the lower lung becomes filled with mucus, though the patient is still breathing quite placidly. If at this stage the patient be turned over on the other side, the mucus begins travelling across the trachea into the opposite lung; is caught on its passage by the in-going air; and is whipped into foam, which at once blocks up the larger air-tubes of the only lung that can work, and so instant distress and danger result. If the life of the patient be not at once destroyed, still the additional shock reduces very much the chances of ultimate recovery. Under these circumstances change of position should always be tentative, and time for some return of nerve-vigour should be allowed before it is attempted. This warning applies with equal force to all cases where mucus or fluid obstructs the air-passages, as in drowning and bronchitis. In drowning, it may be remarked that the water, on entering the lungs, becomes quickly inspissated with mucus, forming a milky foam, which can only be slowly evacuated by the application of Dr. Marshall Hall's or other process of artificial respiration. *See* Artificial Respiration; and Resuscitation.

Robert L. Bowles.

STETHOGRAPH (στῆθος, the chest; and γράφω, I write).

Definition.—An instrument for recording the movements of the chest.

The indices in stethometers are adapted to record maximum expansion at any one point. Dr. Sanderson's 'recording stethometer,' described and figured in the *Handbook to the Physiological Laboratory*, consists essentially of a tympanum, on one side of which a knob is fixed, for application to the chest-surface. This tympanum is in communication with a second tympanum by means of an air-tube, and the fluctuations of the second tympanum are recorded by a writer upon a revolving surface of paper. By means of this instrument, properly adjusted, the respiratory movements of the chest at any point can be recorded, as regards both depth and rhythm.

R. Douglas Powell.

STETHOMETER (στῆθος, the chest; and μέτρον, a measure).—Synon.: Fr. *Stéthomètre*; Ger. *Stethometer.*

Definition.—An instrument for measuring the mobility of the chest, and of its several parts, during respiration.

Description.—Various forms of stethometer have been designed. Dr. Sibson's 'chest-measurer' consisted of a simple arrangement by which a rod, attached by a movable rack to an index, might be applied vertically in succession to different parts of the chest (see *Sibson's Collected Works*, vol. ii.). Sir Richard Quain's stethometer consists of a cord attached to an index working on a graduated dial (*Lond. Journ. of Med.*, Oct. 1850). Expansion on the two sides may be measured and compared by means of the double tapes, or the soft metal cyrtometers, held so that the ends overlap in the median line. A more elaborate instrument is that of Dr. Ransome, who has with it made valuable observations on the respiratory movements (*Med.-Chir. Trans.*, vol. lxiv., p. 185).

R. Douglas Powell.

STETHOSCOPE (στῆθος, the chest; and σκοπέω, I examine).—Synon.: Fr. *Stéthoscope*; Ger. *Stethoscop.*

Definition.—An instrument employed as a medium for the conduction of sound, between the ear and the chest or other parts, in auscultation.

Description.—Stethoscopes are of various patterns. They are commonly made of a thin, cylindrical piece of wood, perforated through its length, which is of about 6 inches to 8 inches; expanded at one end to a somewhat trumpet-like extremity, for convenient application to the chest; and at the other end provided with a nearly flat, broad surface, to which the ear can be comfortably applied. Some practitioners prefer a solid stethoscope—that is, one in which there is no central canal. Such was Laennec's original instrument. Others prefer the stethoscope to be made of metal; others, again, of vulcanite. An instrument made of cedar-wood, with a perforation of about $\frac{2}{10}$ inch in diameter, a chest-piece about $1\frac{2}{10}$ inch in diameter, and a slightly concave ear-piece $2\frac{1}{2}$ inches to $2\frac{3}{4}$ inches in diameter, is perhaps the best adapted for auscultation.

Many auscultators at the present day use the *binaural stethoscope*, which consists of a short hollow chest-piece, of an elongated conical shape, from which two flexible tubes extend, terminating in metal tubes tipped with ivory, to fill the meatus of the ear on each side. This instrument has some advantages. It can be more readily applied to different parts of the chest without the observer being obliged to adopt constrained postures; and by occupying both ears whilst the chest-piece is applied, it excludes extraneous sounds, and considerably intensifies the chest-sounds. One disadvantage is, that sounds produced in the mouth and throat of the patient, which would be recognised by the disengaged ear of an observer using the ordinary stethoscope, are apt to be mistaken for modified pulmonary sounds. Again, with the aid of the rigid stethoscope impulses of various kinds, cardiac or aneurysmal, not recognisable on ordinary palpation, are very appreciable by the ear, which might escape attention with the binaural instrument. Intensification of auscultatory signs, also, whilst perhaps an advantage in the common run of practice, is not so to persons learning auscultation, and whose hearing is not defective.

The *differential* stethoscope, which is a binaural stethoscope having the tube connected with each ear attached to a separate chest-piece, is useful in some cases of heart-disease, and for simultaneously comparing the two sides of the chest—provided the two ears of the observer are of equal auscultatory power. Finally, some practitioners prefer a single flexible tube, with an ear-piece fitting into the meatus, and a chest-piece. It has been attempted to apply the telephone, and even the microphone, to stethoscopy, but as yet without success.

R. Douglas Powell.

STHENIC (σθένος, strength). — This term is applied, first, to individuals when they are vigorous and strong; and, secondly, to inflammatory diseases, when they assume an active character, such as *sthenic pneumonia*, as distinguished from *asthenic*. *See* Disease, Classification of.

STIFF-NECK.—A popular name for muscular torticollis. *See* Rheumatism, Muscular.

STILLICIDIUM (*stilla*, a drop; and *cado*, I fall).—The falling of a fluid drop by drop. The term is used to express the flowing of the tears over the lower eyelid in obstructions of the lacrymal passages; also the dropping of the urine in strangury (*see* Eye, and its Appendages, Diseases of; and Strangury). As a therapeutic method of application, stillicidium signifies the dropping of a fluid upon a part. *See* Cold, Therapeutics of.

STIMULANTS (*stimulo*, I stir up).—Definition.—A stimulant is anything which increases the natural function of a part, or which causes a slight degree of superficial irritation.

Enumeration.—Stimulants may be divided into *general*, *cardiac*, *vascular*, and *cerebral*, as Alcohol, Ether, Opium, and Ammonia; *spinal*, including Nux vomica, Strychnine, Phosphorus, Morphine, Ergot, and Belladonna; and *stomachic*, as Aromatic oils, Ginger, Capsicum, Mustard, and other so-called carminative substances.

Actions.—Taking the term 'stimulant' in its widest sense, we are bound to admit that it has very close ties of relationship with almost every other therapeutical group. Thus a drastic purgative is a stimulant to the intestinal mucous membrane; and cholagogues promote the secretion of the liver. So we have stimulating diuretics, diaphoretics, and emetics, and drugs which directly stimulate certain organs or glands, as when ergot evacuates the contents of the womb, or jaborandi causes a copious salivary flow. It is quite sufficient for our present purpose, however, merely to direct attention to these bearings of the subject, which receive fuller notice in other articles, and the enumeration already given shows within what limits we must proceed.

General Stimulants.—The agents which are sometimes called 'general stimulants' act, in the first instance, on the nervous structures of the heart, improving the tone and vigour of the circulation; and, as a result of the increased quantity of blood sent to the brain, the intellectual functions seem to be temporarily augmented. Alcohol in small quantity undoubtedly makes the pulse larger and firmer; gives rise to a pleasant glow and sensation of general warmth; and appears to lend rapidity and freedom to the cerebral operations. Opium, in small doses, has much the same effect. But pushed beyond this point, or given in larger quantity, both these drugs enter upon their sedative and narcotic phase: dulness succeeds the briskness of excited function; and a semi-paralysed condition of nervous energy ensues, ending in sleep. Diffusible stimulants, as they are called, such as ether and ammonia, stimulate perhaps less actively in the first instance; but their effects pass more speedily away, and are not succeeded by any prolonged or well-marked period of subsequent depression.

Vascular Stimulants. — Cardiac and cerebral stimulants are included in what has just been said, but a special division of vascular stimulants is supplied by those drugs which seem to brace up and give tone to weakened vessels. It is thus, no doubt, that we may explain the influence of opium in lending a healthier action to indolent or spreading ulcerations; or to the faculty which quinine seems to possess in some degree of arresting localised suppuration.

Spinal Stimulants.—The best type of spinal stimulant is strychnine, which powerfully excites the reflex functions of the cord, and whose tetanising action is somewhat imitated, in the lower animals at least, by morphine and thebaine. Under this heading we may also include belladonna and carbonate of ammonium, which have a well-marked stimulating influence over the respiratory centre, situated in the medulla oblongata.

Stomachic Stimulants. — Stomachic stimulants run closely on a parallel with tonics, and probably act by gently irritating the mucous membrane, and supplying a sensation strongly resembling the natural physiological craving or desire for food, which constitutes hunger.

Uses.—Whatever views we may hold regarding the propriety of recommending stimulants to persons in full health, the urgent necessity for their administration in certain diseased conditions is one of the fundamental principles of medicine. True although it be that we may often treat acute illness very successfully without alcohol, it is no less an acknowledged fact that, under well-recognised conditions, we are bound to give it to our patients with no sparing hand. When the tongue is becoming dry and brown; when the pulse is weak, soft, rapid, and irregular; when the first sound of the heart is low and muffled; and when muttering delirium is setting in—then we know that the time for wine or spirit has arrived, and that under its judicious use the tongue will moisten, the pulse become slower and firmer, and the sufferer may sink into a refreshing sleep. Good whisky or brandy, or the effervescing wines, are best suited for these emergencies, and must be given at regular intervals and in carefully measured doses, according as the progress of the disease and the condition of the patient seem to render their administration necessary. In convalescence also a little stimulant will promote the appetite and increase the general tone; and good port, Burgundy, or Madeira, or some of the lighter beers, will act well, in virtue of their tonic properties.

Although it seems to be now generally acknowledged that stimulants are not required by the strong and robust, many dwellers in large towns, frequently pursuing unhealthy occupations, subject to much mental strain and worry, and suffering perhaps from depression and want of appetite, derive great benefit from a little sound wine or beer. Under the influence of the stimulant, the secretion of gastric juice is augmented, and more food can be taken and digested; the only caution being that the dose shall be strictly moderate in quantity, and invariably taken with the meals. *See* Alcohol.

The diffusible stimulants also have their place in the treatment of disease when we wish to produce a slighter and more transient effect; and carbonate of ammonium is of especial service in the advanced stages of bronchitis, from its stimulating influence on the respiratory centre.

Nux vomica and strychnine are occasionally used with benefit in spinal disorders when the more acute symptoms have passed away, and when loss of function from sheer debility seems to be the principal obstacle to the recovery of the patient.

The stomachic stimulants find their application in cases when the appetite flags, and when the desire for food requires to be promoted by artificial means. Dwellers in tropical climates make greater use than ourselves of cayenne and other fiery additions to the dietary; and it seems probable that by thus attracting an increased flow of blood to the stomach, more gastric juice may be secreted, and the individual be justified in consuming the greater quantity of food which the increased development of appetite seems to render necessary.

R. Farquharson.

STING: STINGING PLANTS AND ANIMALS.—Synon.: Fr. *Aiguillon*; Ger. *Stachel.*

Definition.—A sting is an abnormal sensation, partly painful, and partly itching in character, usually caused by the introduction beneath the skin of some poison of animal or vegetable origin. Either increment of the sensation may predominate: the stung surface may be simply painful and tender, or the itching may be intense, and lead to considerable scratching for its relief.

In the widest acceptation of the word, the effect produced by the application to the skin of such substances as mustard, cantharides, strong carbolic acid, and the like, may be denominated as stinging; but here it is proposed to consider only the wounds inflicted by stinging plants and animals. The subject of venomous animals is separately discussed. *See* Venom, Effects of; and Venomous Animals.

Ætiology.—The severity of the sensation and of the local constitutional effects of stinging depends, not only on the quality and quantity of the irritant, but also on individual susceptibility; in some persons the effect may be extremely mild and transient, in others severe symptoms may ensue. In respect to the peculiar susceptibility of the person attacked, the greatest difference is observable amongst individuals, and even in the same person at different times. In many of the recorded fatal cases, the victim had been previously stung and had suffered severely. There seems, however, reason to believe that the system becomes more resistant to the effects after repeated stingings, as is seen to be the case among bee-keepers, and those continually exposed to mosquitoes. Some variations in the virulence of the poison, whether of animal or plant, occurs with the season of the year.

Stinging Plants.—These are almost entirely limited to the order *Urticaceæ*, of which the following species are the most important: *U. urens*, *U. dioica* (British), *U. crenulata*, *U. stimulans* (Indian), *U. ferox* (New Zealand), *U. gigas* (New South Wales), which forms lofty trees, and *U. urentissima* (Java). A few species of the order Malpighiaciæ also possess stinging properties.

In the nettles the urticating organs consist of unicellular hairs tapering towards the free end, each of which terminates in a bent knob, and, swelling out at the attached extremity, is received into a cup-shaped depression of a cellular pedicel. The acrid fluid, the nature of which has not been determined, but is supposed to be an acid similar to malic or acetic acid, is regarded as being secreted by the pedicel and stored in the stinging hair, from which it escapes into the integument when the brittle knobbed tip is broken off by contact. The hairs in the Malpighiads are peltate and not tapering.

Stinging Animals.—Urticating organs, known as *trichocysts*, *cnidæ*, or *thread-cells*, similar in function only to the stinging cells of nettles, are found in many animals, such as the Infusoria, some Annelida, and several Nudibranchiate mollusca. They are, however, best developed and most characteristic in the Cœlenterata, of which the jelly-fishes or sea-nettles are the best known. These organs consist of cells, containing an acrid fluid, and prolonged into a long filament which presents numerous modifications of barbs and serrations. The filament is usually spirally coiled within the cell, from which it is everted on contact, conveying the fluid into the surface that it penetrates. Great variety exists in the form, size, and disposition of these organs; in many of the Actinozoa or sea-anemones they are arranged in rope-like clusters, enclosed in fine tubes, within the body-cavity.

The power of stinging is possessed very generally by members of the articulate subkingdom, such as spiders and scorpions among the Arachnida; bees, wasps, mosquitoes, gnats, and ants among the Insecta. The bite of the flea or bug produces itching rather than a sting. In all cases of true stinging an irritant fluid, thought to be of the nature of formic acid, is introduced beneath the skin by some penetrating organ, which may be connected with the mouth or with the terminal segment of the abdomen, and which is in some animals—as bees, but less frequently wasps—torn out and left in the wound when the sting is inflicted.

Effects.—The introduction of the poison of a stinging vegetable or animal is followed, either immediately or within a very short time, by erythema of the affected part, the surface being red, swollen, and exhibiting all degrees of pain and tenderness. If a mucous membrane, as of the mouth, be the seat of the wound, the swelling is intense, the tongue cannot be protruded, and swallowing becomes difficult or even impossible. Nor are the results limited to the locality of the sting, the erythema often spreading to a considerable extent, from the hands or face, which are obviously the most frequent starting-point, to the arms, neck, and trunk, sometimes presenting the appearance of a scarlatiniform or urticarial eruption. Associated with the local manifestations, general symptoms, often of a most severe and even fatal character, have been known to occur. Well-authenticated cases of death from the stings of bees, wasps, scorpions, and even some species of tropical nettles, have been placed on record. In the majority of such cases the poison has brought on a state of syncope; severe prostration, pallor, and pulselessness being the most general symptoms; and death has been known to occur within a quarter of an hour, or from that to a few hours. Other cases, especially of scorpion stings, are characterised by excitement and some delirium; and tetanic spasms even sufficient to cause death have been not infrequently known to follow the stings of bees, wasps, and spiders (*see* Tarantism). When the case does not prove fatal, recovery is generally rapid and the patient is quite well in a day or two; but this is not always so, and the effects of some nettles, for example, *Urtica urentissima*, the Devil's leaf of Java, are said to last for years.

Treatment. — (*a*) *Local.* — Innumerable applications have been suggested as specifics in cases of stinging. Their efficiency, without doubt, depends mainly upon their being applied to the seat of the sting quickly after infliction. The *modus operandi* of many is quite empirical, but others would seem to decompose the irritating material, and so prevent or arrest its effects. Among those most generally resorted to are alkalis, such as liquor ammoniæ or strong solutions of bicarbonate of sodium or potassium; and it is probable that many popular remedies, such as soap, the 'blue-bag,' &c., depend for their effect upon the alkali they contain. Concentrated solutions or even the pure crystals of alum, and tartaric or other vegetable acids, often afford distinct relief if rubbed in at the site of the sting. The bruised leaves of plants such as the dock, or the juice of a raw onion, applied similarly, will act in the same way. For the more serious stings of tropical plants and animals, more potent remedies are necessary, such as the application of lint soaked in chloroform and laid over the wound; poultices of ipecacuanha, or preferably an extract of the same drug made by mixing equal parts of powdered ipecacuan, rectified spirit, and ether; or rubbing the part with hydrate of chloral—pure, or liquefied by mixture with camphor, in the proportion of three parts of the former to one of the latter. Menthol camphor will also relieve the pain and irritation; carbolised oil (1 in 20), or even subcutaneous injections of carbolic acid, have been used. The aromatic oils of pennyroyal, lavender, cloves, or cinnamon smeared over the hands and face, are most effective in preventing the attack of mosquitoes, gnats, &c., and often give relief when applied to the stung part.

In the case of bee-stings it is important to search for and remove any parts of the penetrating organ which may have been left in the wound.

(*b*) *General.*—When symptoms of prostration or collapse are produced, stimulation with brandy, ammonia, or ether is an absolute necessity, and one or other of these should be administered without stint, as recovery undoubtedly depends on counteracting the cardiac depression. W. H. Allchin.

STITCH.—A sharp catching pain in the side, generally associated with pleurisy, pleurodynia, or intercostal neuralgia. *See* Pleura, Diseases of.

STOMACH, Diseases of.—Synon.: Fr. *Maladies de l'Estomac*; Ger. *Krankheiten des Magens.*

The diseases to which the stomach is liable will be considered in the following alphabetical order: (1) and (1*a*) Abscess; (2) Atony; (3) Atrophy; (4) Cancer; (5) Concretions; (6) Contractions; (7) Dilatation; (8) Fibroid Thickening; (9) Gangrene; (10) Hernia; (11) Hyperæmia; (12) Hypertrophy; (13) Inflammation; (14) Lardaceous Disease; (15) Malposition; (16) Morbid Growths; (17) Neuroses; (18) Perforation; (19) Softening; (20) Syphilis; (21) Tubercular Disease; (22) Ulcer; and (23) Vessels, Diseases of.

Several subjects, intimately associated with disorder or disease of the stomach, are discussed separately under special headings. *See* Digestion, Disorders of; Digestive Organs, Diseases of; Eructation; Flatulence; Hæmatemesis; Pylorus, Diseases of; Pyrosis; and Vomiting.

1. Stomach, Abscess in the Walls of.—This is a rare disease, and occurs in two distinct forms. In some cases a *diffused* suppuration is found in the submucous tissue of the stomach, usually in connexion with pyæmia. Acute inflammation of the mucous surface, accompanied by numerous ulcers, is occasionally observed in various infective disorders, and in all probability the form of suppuration just mentioned is the result of the general condition of the system. Under such circumstances symptoms pointing to the implication of the stomach are obscured by those of the general disease.

Abscess of the stomach also occurs as a *circumscribed* collection of pus situated beneath the mucous membrane, often bursting into the cavity of the organ through small openings. It is said by Leube that when such abscesses open into the stomach cicatrisation may take place, with consequent contraction of the lumen of the organ. Most cases have occurred in males. The causes to which the disease has been attributed seem to be too slight to produce such a serious malady. Thus, it has been ascribed to the abuse of spirituous liquors, to over-feeding, to errors in diet, and in a few cases to injuries. The late Dr. Brinton describes the symptoms of this form of gastritis as 'violent pain, and tenderness in the region of the stomach, attended by severe and frequent vomiting, and by high febrile reaction. The pain and vomiting increase in severity, and the tenderness becomes so excessive as to suggest peritonitis; the more so that it is often accompanied by some tympanites, which, however, like itself, sometimes differs from that of general peritonitis in being limited to the epigastrium. By-and-by jaundice may come on. In any case the febrile excitement rapidly merges into prostration, which is associated with delirium, and ends in death in from forty-eight hours to a few days from the commencement of the attack.'

Leube mentions 'that in two cases a tumour, which in one case was as large as the fist, and not particularly painful upon pressure, could be felt in the epigastrium.' It is somewhat surprising that in many of the cases recorded it is stated there was no tenderness on pressure, a circumstance that must be very apt to mislead the practitioner as to the true nature of the malady. In some instances general peritonitis has accompanied the disorder, rendering the diagnosis still more difficult.

TREATMENT. — When the suppuration in the walls of the stomach is secondary to an acute infectious disorder, the treatment of the local complication is of course secondary to that from which it has arisen. As regards circumscribed abscess, from the rarity of the disease, and the frequent absence of all symptoms pointing to an affection of the stomach, few cases have been diagnosed during life, and consequently the treatment has been directed solely to the relief of such effects as vomiting and peritonitis. In case a tumour should be discovered in the epigastrium in a patient suffering from high fever, the propriety of making an exploratory opening must be considered, inasmuch as if the abscess should prove to be external to, and not in the walls of the stomach, a free opening would be the only means likely to be followed by a good result.

1*a*. Stomach, Abscess around the.—SYNON.: Perigastric Abscess.—An abscess occasionally presents itself in the neighbourhood of the stomach, and, on account of the difficulty of the diagnosis, often escapes recognition during the life of the patient.

ÆTIOLOGY AND SYMPTOMS. — Perigastric abscess is usually a complication of gastric ulcer. Only two of the patients whose histories have been reported are said to have enjoyed good health before their final illness. The others had suffered from pain in the epigastrium or abdomen, but in only two is there any mention of hæmatemesis. The great length of time during which the symptoms of gastric ulcer had been experienced is very striking. It is therefore evident that it is only in the very chronic cases of this disease that we can expect the occurrence of perigastric abscess. The final illness of which the patients died was usually ushered in by severe symptoms, and was of short duration. In seven out of twenty-three cases in which details are afforded, sudden collapse occurred, accompanied or followed by pain in the abdomen, tenderness on pressure, distension, and other symptoms of peritonitis. In eleven there was no collapse, but the pain in the epigastrium, from which the patient had previously suffered, suddenly became very severe. The absence of rigors is worthy of remark, as we might naturally have expected they would have accompanied the formation of pus. Details are given in nine cases where collapse was not present, and in all of them severe and continuous pain in the epigastrium or abdomen persisted until death, but there is no record, as might have been expected, of constant vomiting.

Fever is mentioned as a prominent symptom in all. Four of the cases died within two weeks, and two lived more than one month after the commencement of the final illness. Occasionally, temporary recovery ensued; and instances are recorded where the patient was able to return to his employment, and was afterwards attacked with general peritonitis produced by the rupture of the abscess.

PHYSICAL SIGNS.—In a small number of cases no evidence of communication between the stomach and the abscess could be discovered. The physical signs in these cases are, of course, somewhat different from those where such a communication exists, as the contents of the abscess consist in the former of fluid only, whilst in the latter gas and liquid are intermixed. A tumour capable of being distinguished externally is mentioned in only six of the cases of simple ulcer of the stomach, but it was always present when the disease was associated with cancer. The rarity of an external tumour is explained when we remember that in most instances the pus lies very deeply, and is in relation with the diaphragm. In most cases the percussion-note was at first dull, but afterwards it became tympanitic. In one the sound was at first dull, afterwards tympanitic; the tumour then decreased in bulk, after an attack of diarrhœa, and finally disappeared, the contents of the abscess having been discharged through the diaphragm. In another, the line of dulness varied according to the position of the patient, showing that the cavity was of considerable size, and that it contained both air and liquid. The affected side was often considerably enlarged, even when there was no tumour to be felt; and in some cases, where the pus was situated below the diaphragm, the liver or spleen was found to be depressed. In all cases, unless the abscess was of very small size, the diaphragm was thrust upwards and the lower lobes of the lungs were compressed, a condition accompanied by dulness on percussion and increased tactile fremitus, and usually by fine crepitation. If the abscess burst into the pleura, the ordinary evidences of pneumothorax presented themselves. Left pleuritic effusion is occasionally established before, or independently of, actual perforation.

Diagnosis.—When a patient who has long suffered from the symptoms of gastric ulcer is suddenly seized with very severe pain of the epigastrium, which does not spread over the whole abdomen, but is attended by collapse, and when, on recovery from the collapse, the pain persists, with tenderness on pressure and considerable fever, the practitioner may suspect the formation of perigastric abscess. His suspicions will be strengthened if a tumour can be discovered which is tender on pressure, or if a well-marked area of dulness is shown by percussion, which is afterwards replaced by a tympanitic note; or if the left hypochondrium becomes enlarged, or the base of the left lung becomes dull on percussion, accompanied by crepitation and by an increase, not a diminution, of the tactile fremitus. Where perforation of the diaphragm has taken place, the signs of pneumothorax present themselves; but a subphrenic perigastric abscess containing air and pus may give rise to very similar indications. In pneumothorax there is usually a history of cough, dyspnœa, hæmoptysis, or other signs of pulmonary disease; whilst in perigastric abscess the patient has previously complained of pain after food, dyspepsia, or other symptoms pointing to disorder of the digestion. In the former, the whole of the affected side is enlarged, the intercostal spaces are flattened, and the movements of the chest are everywhere absent; whilst, in the latter, the lower part of the chest only is distended, and the upper portion of the affected side still moves on respiration. In pneumothorax there is an absence of the respiratory murmur and of the tactile fremitus all over the affected side; whilst in perigastric abscess the respiratory murmur can be heard for some distance down the side, and is audible at a lower point in forced inspiration than in ordinary breathing. In addition to this, the amphoric sounds are often audible over the whole abdomen, and even to the bottom of the spine, in perigastric abscess, instead of being confined to the immediate neighbourhood of the thorax; the heart is generally pushed to the opposite side in pneumothorax, but is only tilted upwards in the case of perigastric abscess.

Treatment.—In the early stages the practitioner must insist on perfect rest, the least movement of the body being strictly prohibited. Opium should be administered, in order to relieve pain, diminish shock, and prevent vomiting. All food should be withdrawn, and the patient supported on nutrient enemata alone. When clear evidence of the formation of an abscess is obtained, an opening should be made into it, a drainage-tube inserted, and the case treated on surgical principles.

2. **Stomach, Atony of.**—There are numerous cases of indigestion in which the most careful inquiry fails to ascertain any structural change in the stomach. These are usually classed under the head of 'atonic dyspepsia'; and the symptoms seem to arise either from an imperfect secretion of gastric juice, or from the muscular movements of the organ being so enfeebled that the food is allowed to remain an undue length of time in the first part of the digestive canal, or from both of these conditions conjoined.

Ætiology.—A feeble state of the digestion may occur at all ages, but more especially in the decline of life. The stomach, like all other glands, loses its power of secretion as age advances, and consequently we find dyspepsia a common complaint amongst the old. Fibroid changes present themselves in the pyloric end of the stomach in most persons who have passed middle age, the secreting tubes undergoing more or less atrophy, and the adenoid tissue increasing in amount. Females are more liable to atony of the stomach than males, who are more apt to suffer from inflammatory changes in the gastric mucous membrane. It cannot be too much impressed upon the mind of the practitioner that an enfeebled condition of the stomach is a constant result of gastritis, and also that a diminution in the power of the digestion predisposes to attacks of inflammation. Atonic dyspepsia may be an hereditary disease; and when this is the case the symptoms usually manifest themselves at an early period of life. So long as the growth of the body continues, little trouble is experienced in such cases; but from twenty to thirty, when the necessity for great activity of the nutritive power ceases, the patient feels himself incapable of digesting his food as easily as before. It is not, however, necessary that the child should experience the same form of gastric disorder as his parent, for the one may suffer from mere feebleness of digestion, whilst the other may have been liable to the inflammatory form of dyspepsia. It is, perhaps, scarcely necessary to observe that there is no complaint so liable to be excited by errors in diet. A stomach which, although it performs its functions feebly, may be able to digest as much food as is requisite for the maintenance of health, is often incapable of disposing of enough to satisfy the desires of a person who seeks his pleasure in the gratification of his palate. Consequently, one of the most common causes of atonic dyspepsia, more especially amongst the richer classes of society, is to be found in the undue frequency of meals. Every practitioner is consulted by persons complaining of dyspepsia, resulting from food being taken every two or three hours, under the supposition that they are suffering from debility. In reality, the feeling of exhaustion from which they suffer arises from the stomach never being allowed a sufficient period of repose. It is called into renewed activity by the introduction of fresh food before the last meal has passed into the duodenum. Imperfect digestion is the necessary consequence, and only a small portion of what is eaten is assimilated and reaches the blood. On the other hand, atonic dyspepsia constantly arises amongst the poor from an imperfect supply of food, or from the food not being of a sufficiently nutritious nature, or from the long and irregular intervals between meals. An immoderate use of alcoholic liquors seems chiefly to favour the production of gastritis; but the writers have seen those who had habituated themselves to much indulgence become the victims of feeble digestion as soon as they have abandoned the use of stimulants. Persons who live chiefly on liquids, such as tea and soup, are more liable than others to feeble digestion. In all probability the mucous membrane becomes relaxed, and the gastric juice is too much diluted to dissolve the food with the requisite rapidity. Insufficient exercise is another very common cause of the complaint, and those who lead indolent and luxurious lives pay the penalty in the shape of dyspepsia. In a state of health the activity of one portion of the digestive tube seems to be regulated by that of other parts of the canal, so that an imperfect contraction of the large intestine induces a corresponding inertia in the muscular coat of the stomach. In consequence of this, constipation is found to be one of the most common causes of this form of indigestion, and it is partly by producing this symptom that sedentary occupations exercise such a prejudicial influence. As the gastric fluid is secreted from the blood, it is evident that a normal amount and quality of the latter must be necessary for the perfect performance of the digestive process. Consequently, we find that the digestion becomes feeble in all cases of anæmia, however this condition may have been produced, as by long-standing leucorrhœa or other discharges. The nervous system controls not only the secretion of the gastric fluid, but also the muscular action of the organ. Any deviation, therefore, from its normal state is apt to be attended with an alteration in the secretion and movements of the stomach.

SYMPTOMS.—The invasion of atonic dyspepsia is gradual, and in a large proportion of the cases the symptoms replace those of acute or chronic gastritis. In ordinary cases there is not any severe pain, but the patient often complains of a feeling of fulness and distension after meals, which begins shortly after eating, and lasts for an hour or two. In other instances there is a sensation of constriction, produced by flatulence, which affects the lower part of the chest, and is relieved by eructation. Occasionally the pain radiates to the shoulders, or passes down the left arm and hand so severely as to simulate angina pectoris (*see* ANGINA PECTORIS). It is distinguished from that complaint by coming on shortly after food, and not after exertion. When, however, the nervous system is much enfeebled, fermentation may be set up by an imperfect secretion of gastric juice, and the pain may then be very severe, and come on immediately after food has been taken. Under such circumstances, the case may so closely simulate gastric ulcer, that it may be at first impossible to distinguish it from that affection. In other instances the constriction is accompanied by dyspnœa, arising, no doubt, from the movements of the diaphragm being impeded through its being pushed upwards by the distended stomach. In men of advanced age who are inclined to obesity, there may be considerable embarrassment of the pulmonary and cardiac functions from this cause, especially where any unusual exertion is undertaken after a meal. It is, perhaps, unnecessary to say that in hysterical persons, and in those whose nervous systems have been unduly excited by alcohol, there is often a shrinking from the slightest touch upon the skin. In these conditions the tenderness is diffused over a considerable surface, not limited to one spot, as in gastric ulcer. It is not increased by deep pressure, and is often most loudly complained of when the hand is applied to a part distant from the stomach. Vomiting rarely presents itself, excepting as the result of some temporary error in diet, or as an accompaniment of hysteria or phthisis. Eructations are generally troublesome; but, instead of the acidity that accompanies catarrhal inflammation of the stomach, only gas or small portions of undigested food are returned. The appetite is deficient; in some cases there is a craving for various indigestible substances, but this is not so common as in the inflammatory affections of the stomach. Sometimes there is an aversion from all food. The tongue is usually broad, flabby, and indented by the teeth. Thirst as a rule is absent. The large intestine corresponds in the feebleness of its functional power. The bowels are consequently constipated, the stools disordered, and, in many cases, they contain a large amount of undigested food. The most common appearance is of pieces of fibre-like tissue that have escaped the action of the stomach, and which are often mistaken by patients for worms. The urine is usually pale and of low specific gravity. If it deposits lithates, the sediment is pale in colour ; more generally oxalates or phosphates make their appearance. A long continuance of imperfect digestion produces loss of flesh and strength, but never to the extent that occurs in the organic affections of the stomach. The pulse is slow and feeble. The heart is especially apt to be affected by functional disturbance. Often the patient complains of a sudden tumbling sensation, as though the heart had turned over ; at other times the palpitation comes on after exertion, and relief is obtained by stooping, or some other change of posture. Some are chiefly tormented at nights. They are awakened at two or three o'clock in the morning with violent and irregular palpitation. Such cases occur most frequently in the old, and often indicate a fatty condition of the heart. The skin is cold and clammy; and irregularities in the circulation, producing coldness of the hands or feet, are constant sources of complaint.

The nervous symptoms constitute the most distressing manifestations of the disease, more especially when the affection itself arises from an exhausted condition of the nervous system. The patient awakes at two or three in the morning, and is unable to sleep for many hours, when perhaps he falls into a troubled and unrefreshing slumber. There is often great irritability of temper, gloom obscures the mind, or the patient is incapable of concentrating his mental powers, or he becomes feeble and irresolute in character. Attacks of vertigo are not infrequent in nervous persons, and are often more dreaded than any other symptom. They occur chiefly after food, but may take place during the night.

Physical Signs.—The chief physical sign in atonic dyspepsia is that presented by the dilatation of the stomach that so often accompanies it. Percussion in such cases shows the organ reaching below the umbilicus, and the distension may remain for some hours after even a moderate meal. The splashing of the contents of the stomach by every sudden movement of the body is often a source of great anxiety to the nervous patients suffering from this disorder.

Various attempts have been made of late years to estimate with some degree of exactness the activity of the gastric secretion, and of the contraction of the muscular coat of the stomach, in atonic dyspepsia. Capsules containing iodide of potassium have been fastened down with threads of fibrin, and the patient has been directed to swallow one of these. Ordinarily iodide of potassium when taken into the stomach is excreted by the salivary glands in a period varying from six and a half to eleven minutes; so that the time that elapses, in addition to this, before the salt appears in the saliva is assumed to represent the number of minutes required for the solution of the threads of fibrin by the gastric juice.

The activity of the motor power of the stomach has been attempted to be estimated by the administration of salol, a substance that is not decomposed into salicylic acid until it has reached the intestines. The salicylic acid can be recognised in the urine by the violet colour produced by the addition of perchloride of iron, so that the period which elapses between the administration of the salol and the appearance of the reaction in the urine is supposed to represent its sojourn in the stomach.

Although these and other tests of a similar character have been frequently used by the writers, they are of opinion that the indications presented by them are of but little practical value. The difficulty in atonic dyspepsia is not to prove that the digestion is proceeding more slowly than in the normal state, but to ascertain the cause that has given rise to the enfeeblement of the digestive process.

Diagnosis.—In ordinary cases we have to distinguish atonic dyspepsia from inflammatory affections of the stomach, and this is often very difficult, inasmuch as an enfeebled state of the stomach often results from gastric catarrh, whilst, on the other hand, the long retention of the food in the stomach often sets up inflammation of the mucous membrane. The chief differences are as follows: In atonic dyspepsia there is no epigastric tenderness, which is usually present in gastritis. There is no pain excepting what may easily be referred to flatulent distension; and acidity and heartburn are much more rare than in the latter. Vomiting, again, is unusual in atonic dyspepsia; common in gastritis. The tongue is broad, flabby, and tolerably clean, and forms a striking contrast to its injected tip and edges, and thick coating in the latter affection. The urine is pale, depositing oxalates or phosphates, in a feeble state of the stomach; high-coloured, and loaded with lithates, when the organ is inflamed. The symptoms of atonic dyspepsia occasionally usher in the early stages of malignant disease of the stomach, and if a tumour cannot be discovered, a mistake may be easily made. The chief points to be remembered are, that emaciation and anæmia are much more rapid in cancer, pain is rarely absent, and the vomited materials may present, even in an early stage, indications of blood. The more common difficulty, however, is to distinguish atonic dyspepsia in persons of a nervous temperament—when it is often associated with severe pain, from chronic ulcer of the stomach. In some instances a correct conclusion can only be arrived at after the case has been watched for some time, and it is wise, therefore, to assume that the patient is the subject of ulcer, and to direct the treatment accordingly. In this form of atonic dyspepsia, however, the pain comes on more immediately after a meal than in ulcer, it is less dependent on the nature of the food, it varies in intensity from day to day, the tenderness is less localised, the amount of flatulence is much greater, eructation affords more relief, vomiting is more rare, there is an absence of hæmatemesis, and the patient complains of various other symptoms referable to an exhausted state of the nervous system.

Treatment.—Before commencing the treatment of atonic dyspepsia by means of tonics, the practitioner should ascertain if the symptoms from which the patient is suffering are the result of the fermentation of the contents of the stomach. This is more especially necessary in those cases of nervous dyspepsia to which reference has been already made, as presenting symptoms simulating those of gastric ulcer. In such it will be found useful to restrict the patient for a week or ten days to milk if it agree, beef-tea, chicken-broth, or peptonised foods, given frequently and in small quantities, whilst the fermentation of the contents of the stomach is arrested by means of carbolic acid or creasote. The bowels must be at the same time carefully regulated by some mild aperient or by the use of enemata.

In ordinary cases the first and most important point is to remove, as far as possible, all the causes of the disease. Again, the food should be of such a nature as will require the least possible exertion on the part of the stomach. Thus, lightly cooked mutton, white fish, chicken, or game are more easily digested than beef, pork, or veal. Roast meat is more digestible than boiled. Soups and broths should be avoided, as well as any large quantity of hot tea or coffee. In bad cases vegetables had better be omitted from the dietary for a time; but as soon as the patient improves they may be again employed. Great mischief is often done by forbidding for a length of time all vegetable food; for, although the flatulence and other symptoms may be thereby relieved, the general health soon suffers. In many cases it will be found useful, where we are forced to forbid vegetables, to order one or two tablespoonfuls of lemon juice daily. This may be either taken diluted with water, or squeezed from the lemon over the meat. When there is much tendency to acidity, light puddings and farinaceous food must be sparingly used, but otherwise they generally agree well. Pastry, cheese, pickles, and newly baked bread should be avoided in all cases.

When a person of middle age and inclined to obesity is troubled with feeble digestion it is better that he should avoid potatoes, spirituous liquors, sweets, and fatty substances; and that he should use dry toast instead of bread, and a simple but varied diet. A dinner-pill of rhubarb, ipecacuanha, and ginger may be given to aid digestion, accompanied by a nervine tonic, such as strychnine or tincture of nux vomica, combined with diluted nitro-hydrochloric acid.

Innumerable remedies are recommended for this form of indigestion, but in order that they should be usefully employed it is necessary to ascertain the cause from which the imperfect secretion of gastric juice has arisen. In a large proportion of the cases the feeble condition of the mucous membrane has resulted from previous inflammation. There is a second class where, although the gland-structure is normal, the blood is deficient in quantity, or is abnormal in quality. In a third the defect originates with an exhausted condition of the nervous centres. Each of these states requires a separate medicinal treatment, and, although one often merges into, or is associated with, another condition, yet the features of one or other appear more prominently in each case that comes under our notice.

Where the feeble digestion has arisen from a relaxed state of the mucous membrane produced by previous inflammation, the tonic should be of an astringent character. It is in such cases that the nitric, nitro-hydrochloric, or phosphoric acid, either alone or in combination with bitter infusion, is required. Acids are best given when the stomach is empty, so that they may directly affect the vascular system of the organ. If metallic preparations are preferred, the perchloride of iron may be used. Notwithstanding the adverse opinions of many authors, the writers have often found pepsin very valuable in these cases. The pepsina porci is the best preparation, and it may be given along with capsicum or ipecacuanha before, not after, meals. One reason why pepsin so often proves inefficacious is that it is not administered in sufficient doses. In cases of feeble digestion in young children or aged persons, much benefit will sometimes result from the addition of pepsin, in larger quantities than usually prescribed, to milk, warmed, and left to stand a short time before being taken; or peptonised food may be ordered in some cases. *See* Peptonised Food.

Where the dyspepsia arises from anæmia, recourse must be had to iron. If it is connected with excessive menstrual discharge or leucorrhœa, the writers have often found the phosphate of iron and manganese a useful preparation. In other cases it may be combined with quinine. The saccharated carbonate and the ammonio-citrate of iron are very valuable and unirritating salts. It is a good plan in these cases to alternate the iron with other tonics, and as liberal a diet should be given as can be easily digested.

Where the nervous system is chiefly in fault, preparations of nux vomica and phosphorus, or those of zinc and arsenic, are chiefly of use. Zinc may be given as the valerianate along with quinine, or as the superphosphate in combination with iron. It is in this class of cases that the nitrate and oxide of silver are chiefly valuable.

The colon is usually as atonic as the stomach, and therefore the bowels require attention in almost every case that occurs. All severe purgatives should be avoided; for nothing so increases the feebleness of the digestion as the indiscriminate employment of this class of drugs. Salines, such as the sulphate of magnesium, and the various mineral waters, must be especially prohibited. The most useful aperients are rhubarb pill, combined with nux vomica or belladonna. When there is no affection of the rectum, the extract of aloes answers well; or if this part is irritable, some mild aperient, such as senna electuary, may be employed. Where a slight amount of acidity is present, the compound rhubarb powder, or an occasional dose of soda and rhubarb, is most suitable.

3. **Stomach, Atrophy of.**—Atrophy of portions of the gland-structure of the stomach is exceedingly common, although sufficient usually remains intact to enable the organ to perform its functions. According to the experience of the writers, a certain amount of anatomical change occurs in every person after he has reached the middle period of life, when the necessity for a superabundant supply of nutriment has ceased. It takes place first in the pyloric region, and tends gradually to extend as age advances. Caution is required in the investigation of such changes in the case of the stomach, lest the effects of *post-mortem* digestion should be mistaken for those of disease.

Anatomical Characters.—In atrophy of the stomach the mucous membrane usually escapes *post-mortem* digestion; it is thin, smooth, and firmly adherent to the subjacent coats. Microscopically, in the earlier stage of the disease the solitary glands are enlarged, and filled with cells and nuclei. The gastric tubes, and sometimes the subjacent muscular fibres, are displaced by these bodies, which are scattered everywhere through the membrane. The tubes adhere firmly to each other, but they still contain normal cells. Later in the disease the solitary glands appear empty in their centres, but are surrounded by thick layers of nuclei; the tubes can no longer be traced throughout their whole extent, and are only recognised as bulbs filled with fatty cells, or as lines of cells, whilst the whole tissue is obscured by fatty and granular matters. In the last stage the solitary glands have disappeared, and the tubes are replaced by fibrous tissue. In some cases observed by the writers, although the mucous membrane was very thin, it was so fatty that 33 per cent. was removed when digested in ether. These anatomical changes seem to produce a concomitant decrease in functional power, as proved experimentally by the writers.

Symptoms and Causes.—Atrophy of the stomach presents itself clinically in three different forms:—

(1) We find it combined with inflammation of some of the other coats of the organ, and proving fatal by the exhaustion of the patient. In one case which came under the writers' notice, the patient gradually succumbed to excessive pain and vomiting, which for twelve months had attended the ingestion of food. Complete atrophy of the gastric mucous membrane was the only morbid condition found at the necropsy.

(2) The second class includes a large number of the cases known as 'idiopathic anæmia;' and, in all probability, the morbid alterations result not from inflammation, but from degeneration. It is evident from these cases that some patients suffering from idiopathic anæmia are really the subjects of atrophy of the stomach. There is not much emaciation, for the pancreas, liver, and absorbing apparatus of the intestines are capable of digesting and taking up the fat. But the heart, like the other tissues, becomes loaded with fatty matter; and it has therefore often happened that the general feebleness and evident want of blood have been attributed to this state of the centre of the circulation, and the patient has been said to have died of 'fatty heart.'

(3) There is a third class of cases in which atrophy of the stomach occurs, without any very definite symptoms during life pointing to the organ thus seriously diseased. The writers carefully examined the gastric mucous membrane in fifty-seven persons who had died of cancer affecting various organs of the body. Fifteen of these were females, who suffered from cancer of the breast, and of these 75 per cent. presented well-marked atrophy of the glandular structure of the stomach. In twenty-four there was disease of the uterus, and gastric atrophy was present only in three of these; whilst no case occurred

amongst persons affected with malignant disease of the glands, bones, or skin. It is evident, therefore, that the atrophy of the stomach only accompanies certain forms of cancer. In those cases of cancer of the breast where the microscope disclosed atrophy, the mucous membrane was much attenuated and its weight diminished; in one case it only weighed 360 grains, the average weight in females dying from other diseases being 720 grains. The amount of pepsin contained in the gland-structure was, in every case in which it was tested, remarkably deficient. The diminution in the weight of the mucous membrane in these cases was not the result of a general wasting of the body, for in cancer of the uterus the average weight was 660 grains. The co-existence of this serious disease of the stomach with cancer of the breast supplies us with an explanation of the fact that many cases die some time after an operation has been performed, in whom there has been but a trifling reappearance of the malignant growth, and no great amount of discharge or of bleeding, to account for the gradual loss of flesh and strength. The writers have seen different cases of this kind, and have remarked that the cancerous tumour is usually slow in its growth and liable to contract, and that eventually nodules form in different parts of the skin. The dyspeptic symptoms are limited to failure in appetite, often a disgust for animal food, and flatulence, accompanied by a gradual loss of flesh, strength, and colour.

Diagnosis.—Atrophy of the stomach can only be diagnosed by the exclusion of all other diseases that tend to produce anæmia. When we meet with a case of progressive anæmia in a person of middle life, we should also examine the blood in order to exclude leukæmia. In this disease, as is well known, the white blood-cells are greatly increased in number, whilst the writers have found in atrophy of the stomach a diminution in both kinds of cells. Where we find this and other diseases absent, no discoloration of the skin, and no signs of malignant disease, we may fairly suspect the presence of gastric atrophy. This suspicion will be strengthened if there can be proved to be an absence of free hydrochloric acid in the contents of the stomach during digestion, and if the patient is affected with cancer of the breast, or a hard malignant tumour of any other organ.

Treatment.—The most important point in treatment is the regulation of the diet. As there is usually a great distaste for animal food, the ingenuity of the practitioner is often severely taxed to discover some form of food likely to furnish albumen to the system, which the patient can be prevailed upon to take. The articles of diet that usually agree best are mutton, chicken, game, soles, whiting, flounder, turbot, haddock, and oysters. It is often necessary to order that the meat should be used as a panada, or minced, so that it may be swallowed quickly. Milk and eggs, where they agree, are invaluable, and in the later stages soups and animal broths may be substituted for solid food. The writers have often recommended various kinds of peptonised food with advantage. In some cases gluten bread and gluten chocolate answer well. Other articles of diet, composed of starch and sugar, are usually more readily taken, and more easily digested.

As regards medicines, iron in all forms is beneficial. It may be combined with strychnine, quinine, or other bitters, according to the circumstances of the case. Arsenic may be used with advantage, but it will be found a good plan to alternate it with other tonics. Pepsin is often prescribed, but it does not produce much benefit. Acids are frequently valuable, the most useful being the hydrochloric and phosphoric. They are best given shortly after a meal.

Change of air, travelling, and freedom from the cares of business, are generally of more use in retarding the progress of the disease than any drugs we can prescribe.

4. **Stomach, Cancer of.** — Malignant disease of this organ is much less common than simple ulceration, but nevertheless the stomach is more frequently the seat of cancer than any other organ in the body, with the exception of the uterus. It is almost always primary, unless it arise from an extension of disease from some of the neighbouring organs. Secondary malignant affections of the stomach are exceedingly rare.

Ætiology.—Males are generally said to be more liable to gastric cancer than the opposite sex, but this has been called in question. Dr. Welch states that of 2,214 cases he had collected from hospital statistics, 1,233 were males and 981 females, being a ratio of about 5 males to 4 females. Of 115 cases taken by the writers from the *post-mortem* records of the London Hospital, 80 were males and only 35 females. Age seems to have an important influence in predisposing to the malady; thus Dr. Brinton collected 600 cases, and found the average age at death to be 50; the greatest liability being between 60 and 70. Dr. Welch analysed 2,038 cases obtained from various sources, and found that three-fourths of all gastric cancers occur between 40 and 70 years of age. The earliest age that has come under the notice of the writers was 25.

Cases have been recorded in which an old ulcer of the stomach or a cicatrix has been attacked by cancer, and two instances of this have come under the notice of the writers. Cancer of the stomach has been stated by some to have resulted from an injury; and in the hospital records one case is mentioned as having closely followed a severe blow on the abdomen.

It is somewhat strange that other visceral diseases are uncommon in the subjects of cancer of the stomach. From this fact it appears that gastric cancer is especially apt to present itself, not in those who have been the subjects of chronic disease, but in such as up to middle life have been in the enjoyment of good health. In a large number of cases there is a history of hereditary transmission; and so completely is this established, that the mere fact of more than one member of a family having suffered from cancer would lead us to diagnose its presence in a doubtful case. Neither anxiety, poverty, nor intemperance seems to influence the development of the disease.

ANATOMICAL CHARACTERS.—All the varieties of cancer are met with in the stomach, but scirrhus is by far the most common. According to the researches of Dr. Brinton, it constitutes 72 per cent. of all the cases. Next in order of frequency he places the medullary form, which amounts to 18 per cent. Colloid cancer is much more infrequent, excepting when in combination with scirrhus. These different forms are, however, very often combined with each other. Microscopically the new-growths present the ordinary appearances characteristic of the forms of the disease to which they severally belong. Cancer seems generally to begin in the submucous tissue, and spreads from thence to the other coats. The muscular structures vary in appearance in different cases. In some the normal tissue has been completely destroyed, and what appears to the naked eye as muscle proves to be, under the microscope, a mass of cancer-cells and fibrous stroma. In other cases we find, even at some distance from the disease, the muscular bundles much increased in thickness, and the contractile fibre-cells greatly enlarged, with very prominent nuclei. Again, the pressure of the new-growth puts a stop to nutrition, so that the muscular bundles seem to be reduced to a mere mass of fibrous threads. Of equal interest are the changes produced in the mucous membrane. Over the tumour the glandular tissue is generally destroyed, and nothing but cells and connective tissue represent the original texture. But in every case examined by the writers, extensive disorganisation of the glandular structures has been found at a distance from the original disease. This is most marked in scirrhus, where we meet with well-marked signs of interstitial inflammation, the tubes being atrophied, and often reduced to mere bulbs filled with fatty cells. Where the softer varieties of cancer form the main portion of the disease, the tubes are everywhere apparent, but are unusually loaded with cells, whilst between and below them nucleated cells are everywhere profusely scattered. This destruction of the glandular structures in cancer of the stomach is in marked contrast to what we find in cases of simple ulcer, for in this the normal condition of the tubes can be readily seen at a very short distance from the edge of the sore.

Cancer in the majority of cases attacks one of the orifices of the stomach, according to Dr. Brinton the pylorus being the seat of the disease in 60 per cent., the cardiac orifice being implicated in only 13 per cent. Dr. Welch states that out of 1,300 compiled cases the pyloric region was affected in 60 per cent., the cardiac in 8 per cent., the lesser curvature in 11 per cent., and the whole or greater part of the organ in about 5 per cent. The records of the London Hospital afford a somewhat different estimate; the pyloric region being the chief seat of the growth in 56 per cent., the cardiac in 8 per cent., the smaller curvature in 16 per cent., whilst the body of the organ was more or less generally affected in 20 per cent. It is evident, therefore, that the part chiefly affected is the pylorus, and that most of the tumours of the stomach that present themselves during life must be situated in that region.

The effect of cancer of the stomach in producing alterations in the shape of the organ, and in its relations to the neighbouring parts, is very important as regards the diagnosis of the disease; and it will be necessary again to recur to the records of the London Hospital. It is stated to have been much contracted in 8 cases, and much dilated in 23. Its normal situation was altered in a considerable number of cases by adhesions to the neighbouring parts. In one instance it occupied a vertical position, from having become attached to a huge cancerous mass that involved the upper portion of the uterus and the ovaries. It is of great importance, in respect to the removal of the pylorus in case of cancer, to ascertain the frequency with which the disease tends to affect the neighbouring structures. When the pylorus was chiefly or alone the seat of the mischief, the peritoneum presented secondary growths in 8 cases, the liver in 26, the pancreas in 16, the neighbouring glands in 23, the lungs in 4, and the pleura in 2. From the rapidity with which the disease spreads, and from its tendency to implicate all the neighbouring structures, it is evident that any operation, to prove successful, must be undertaken at a very early period of the malady. In addition to infection of other organs, perforation may occur into the colon and the peritoneum; and in some cases a communication may be effected between the organ and the parietes of the abdomen. Death is sometimes due to hæmorrhage, but this accident is more rare than in simple gastric ulcer.

SYMPTOMS. — The symptoms of gastric cancer usually show themselves very insidiously. The patient complains of slight disturbance of digestion, acidity, flatulence, or want of appetite. It has been stated that in the majority of cases there has been no previous liability to dyspepsia. No certain rule can be laid down respecting this point. In some the fatal illness has been ushered in by hæmatemesis; but this is uncommon. Pain is one of the most prominent symptoms. At first it is only slight, and is often described as a dull, gnawing sensation, but, as the complaint progresses, it assumes a more neuralgic character. Generally, it is referred to the epigastrium; in other instances to the back, or to the hypochondrium. It is ordinarily increased during digestion, but, unlike the pain of ulcer, is often equally severe when the stomach is free from food. The pain of cancer has been said by some authors to be occasionally of a colicky character. This, probably, arises from a co-existing atony of the colon, for in many cases this kind of pain is quite relieved when proper attention is directed to the large intestine. There is generally tenderness on pressure over the seat of cancer, but it is neither so localised, nor so severe, as in simple ulcer. Unless the pylorus is obstructed, there is rarely much complaint of acidity or flatulence. This arises from the fact that the absence of appetite prevents the patient from indulging in any large amount of food. When the growth affects the pylorus, the same symptoms are produced as in obstruction of this opening from any other cause (*see* Pylorus, Diseases of). Vomiting is a very general symptom. It varies greatly, according to the part of the organ affected. In disease of the cardiac orifice it is almost always present, and arises partly from the co-existing affection of the œsophagus. It may thus form the prominent symptom of the disease, occurring directly after food, and proving very rebellious to treatment. When the body of the organ is alone implicated, it may be entirely absent, but in pyloric contraction it usually takes place at a lengthened interval after food. Loss of appetite is almost always present, and it shows itself not only in the later stages, but at a comparatively early period in the disease. The loss of appetite is most marked in scirrhus, and it often forms a useful diagnostic sign, for in simple ulcer the appetite is generally unaffected. The tongue is usually dry, but thirst is seldom much complained of. The bowels are often confined in the earlier stages, from the imperfect muscular action of the upper part of the canal; but as the disease progresses, diarrhœa frequently occurs, and tends to enfeeble the patient. The most striking feature of the disease is the steady and often rapid loss of flesh and strength that accompanies it. We meet in the *post-mortem* room with no other examples of such extreme emaciation as are encountered in bodies after death from this disease. No case ever runs its whole course without this symptom manifesting itself. The lips become pale, and the skin often of a greenish or slightly jaundiced hue. The chief cause of the loss of appetite, the failure in strength, and the change in colour, in gastric cancer is the atrophy of the glandular structure of the stomach. The pulse is ordinarily soft and feeble, for in this, as in other forms of cancer, an enfeebled condition of the heart, arising from a softened, fatty state of its muscular tissue, is commonly present. The temperature is usually below the normal point, and if fever is excited by the occurrence of any local inflammation, the rise of temperature is only temporary. As the disease progresses, other symptoms are generally observed. In some cases ascites occurs; in others œdema of the legs; in others jaundice is produced by the pressure of enlarged glands on the gall-ducts, or by the implication of the liver itself.

Although these are usually the symptoms of gastric cancer, the practitioner must not expect them to be always present. He may be called to a middle-aged or elderly man, in whom rapid loss of flesh, strength, colour, and appetite is the only indication of the fatal disease under which he labours. The patient may assert that he has neither pain, nausea, flatulence, nor, in fact, any symptom pointing to a derangement of his gastric functions. The mere loss of appetite and strength in an elderly person should be sufficient to awaken suspicion, and demand a most careful exploration of all the abdominal organs. There is a form of the disease in which anæmia constitutes the most prominent symptom. In such a condition there may be an absence of pain, and vomiting may be only occasional, but the skin and mucous membranes become gradually paler as the disease advances, and the patient complains of feebleness, loss of flesh, palpitation, and dyspnœa on the slightest exertion. If there is no tumour to be felt, it may be impossible to distinguish such a case from one of pernicious anæmia. The stools should, however, be examined frequently, for a slight and continuous hæmorrhage into the intestinal canal from a cancerous ulcer of the stomach or duodenum may be the cause of the bloodlessness. Severe hæmorrhage is more rare than in simple ulcer, but there is a greater tendency to a constant oozing of blood from the ulcerated surface. The blood, thus slowly effused, is acted upon by the gastric juice, and when vomiting occurs it has the appearance of 'coffee grounds.' This colour of the vomited matter used to be considered as pathognomonic of cancer, but it is now known that it only arises from the blood being slowly effused, and may therefore present itself in other kinds of gastric disease. Peritoneal perforation is more rare than in simple ulcer; but we more frequently meet with communication between the stomach and other organs, such as the colon. Marked relief of the symptoms of cancer may be temporarily afforded by such a perforation, although this is not common. In still more rare cases adhesions occur between the stomach and the parietes of the abdomen, and an external opening is produced.

Course and Duration.—Cancer of the stomach destroys life more rapidly than a similar affection of almost any other organ in the body; and it has been calculated that the average duration of the disease is about one year, the maximum being thirty-six months; whilst the shortest period in which life is destroyed from the first symptoms being noticed is only one month. The encephaloid form is most rapid in its course, because its growth is quicker, and the neighbouring organs, such as the liver and lymphatic glands, are more quickly implicated. Colloid cancer is the slowest in producing death, and most of the more chronic cases have consisted of this form of malignant disease.

Physical Signs.—The chief and most important physical sign presented by gastric cancer is the presence of a tumour. It is usually well-defined, hard, and nodular; and not infrequently isolated nodules can be felt in its neighbourhood. The sound on percussion is generally more or less tympanitic. The tumour is usually found in the epigastrium or right hypochondrium, more rarely near the umbilicus. As a rule it is fixed, and does not move downwards with respiration; but in some instances, where adhesions have not formed, it has been dragged downwards by the weight of the stomach, and has presented itself as low as the hypogastrium. It is most readily discovered when the pylorus, or the smaller curvature, is the part affected. Where the cardiac orifice is the seat of the mischief, the growth may be so deeply situated that, unless it be of large size, it may elude discovery. There are certain chances of error as regards a tumour caused by gastric cancer, against which we should be on our guard. Thus the swelling may arise from a fæculent collection in, or from disease of, the colon. Fæculent tumours are, however, most commonly met with at the sides of the abdomen; they usually permit of being indented by the finger forcibly pressed against them; they are apt to alter their position, and may be partly or completely removed by purgatives. Again, cases are mentioned where the stomach was found filled with string, hair, or cocoa-nut shavings, and in each case a tumour existed during life. The rectus muscle, when in a state of tension, may give rise to the sensation of a tumour, and it is only by altering the position of the patient that the mistake can be obviated. The muscle is seldom tensely contracted so as to produce the appearance of a tumour, unless the parts beneath it are unduly sensitive; and when such a condition is persistent and gives rise to doubt, it can be removed by the exhibition of an anæsthetic.

The writers have known a hydatid tumour of the peritoneum mistaken for gastric cancer; but there was an absence of pain and of loss of flesh and strength, although severe vomiting frequently occurred. Syphilitic tumours of the liver may closely simulate those of gastric cancer; but in such cases the pain is less severe, the tenderness is less marked, vomiting is less frequent, and the temperature usually rises towards evening. Such tumours often rapidly disappear under appropriate treatment.

Occasionally the thickening around a chronic simple ulcer gives rise to an undefined sensation of tumour; but the long duration of the symptoms, severe hæmatemesis, the continuance of the appetite, and the smaller amount of wasting, are usually sufficient to distinguish such a case from gastric cancer. It must not, however, be forgotten that cancer sometimes attacks the cicatrix or edge of an old simple ulcer. Cancer of the pancreas may form a tumour in the epigastrium closely simulating a gastric cancer. In doubtful cases the distinction between a tumour of the stomach and one of the colon may be sometimes assisted by the plan adopted in the following case. A patient was admitted into the London Hospital with a hard tumour below the left hypochondrium. As his symptoms did not definitively point to gastric cancer, there was much difference of opinion as to the nature of the disease. The lowest edge of the tumour was first marked out on the skin, when a considerable quantity of soap and water, well frothed, was injected by the rectum. The edge of the tumour was raised two or three inches, but its note on percussion was not clearer than before. As soon as the bowels had acted freely, the patient was requested to drink a pint of effervescing liquid, and now the edge of the tumour descended considerably, and the note on percussion became more tympanitic. From the injection into the colon raising the tumour, it was plainly not connected with the intestine, whilst from the percussion note becoming clearer after the drinking of the soda-water, it was evident that it overlay, or was in some way connected with, the stomach.

The size of the stomach in gastric cancer varies according to the orifice affected, and in this way may prove a useful aid in diagnosis. When the pylorus is obstructed, the organ is usually enlarged; when the cardiac orifice is narrowed, it becomes diminished in size. We derive less assistance from the examination of the vomited matters than might be expected. In dilated stomach they are in a state of fermentation, and contain sarcinæ and torulæ. Occasionally there are portions of cancerous masses, but, as a general rule, these are too much decomposed to afford satisfactory evidence. In some instances of doubtful cancer, the fluids vomited become quite solid when boiled with liquor potassæ, and this may prove a useful indication in certain cases. The recognition of the amount of free hydrochloric acid in the products of gastric digestion has assumed so much importance of late years, both in the diagnosis and treatment of disorders of the stomach, that it seems desirable here to draw the reader's attention to this subject.

In order to obtain an accurate knowledge of the digestive processes, it is necessary to extract the contents of the stomach at a time when digestion is at the height of its activity; and it is therefore the custom to administer a meal, the quantity and quality of which is known, and to withdraw the products of digestion after the lapse of a definite interval of time by means of the stomach tube. With respect to the composition of this 'trial meal' a great deal of discussion has taken place. One school of Continental physicians (Ewald) prefer to give a light breakfast consisting of a dry roll and three-quarters of a pint of warm milk or weak tea, the products being withdrawn from the stomach one hour afterwards. Leube, Riegel, and their followers, however, recommend a meal to be given at midday, which from its greater abundance may put the secretory powers of the stomach to a severer test. Accordingly they administer a 'trial dinner' consisting of 400 grammes of soup, 60 grammes of meat, and 50 grammes of white bread, the organ being emptied three or four hours afterwards. The semi-digested food is immediately filtered, and the filtrate, which is usually of a clear yellow colour, submitted to a chemical examination. In this undertaking it is advisable to follow a regular and fixed order of procedure, the first point being to ascertain the *reaction* of the fluid; the second to demonstrate the presence of *free hydrochloric acid*; and the third to estimate the *quantity* of it in a percentage form.

(1) To ascertain the *reaction* of the filtrate, a piece of blue litmus-paper is generally employed, the change to a red colour indicating the presence of an acid. But since this acidity may be due either to hydrochloric acid, to acid salts, or to the presence of some acid which has been formed by a process of fermentation (lactic, butyric, acetic), it is necessary to use other reagents in order to demonstrate the existence of each one separately.

(2) Many tests are employed for the recognition of *free hydrochloric acid*. The aniline dyes possess the property of changing colour when brought into contact with a mineral acid, and this fact is made use of chiefly in the case of methyl violet. If an aqueous solution of this substance is prepared, the violet colour instantly becomes sky-blue on the addition of hydrochloric acid, even when it exists in the small proportion of 0·024 per cent. In like manner, a solution of fuchsin becomes yellow, and congo-red a bright blue. A saturated solution of tropäolin 00 is a very convenient test, as the orange colour changes to rose-pink on the addition of a minute quantity of the acid. It must, however, always be borne in mind that certain substances have the power of forming a loose combination with the acid, and completely obscuring the reactions above described. Among such may be mentioned peptones, albumoses, syntonin, leucin, mucus, and chloride of sodium. The most delicate test for free hydrochloric acid consists of phloroglucine, 2 parts; vanillin, 1 part; absolute alcohol, 30 parts. A splinter of wood soaked in this solution, and heated, will change to a red colour in the presence of only 0·005 per cent. of free hydrochloric acid (Günzburg).

Lactic acid is detected with the greatest certainty by means of a reaction recommended by Ueffelmann. To a dilute solution of perchloride of iron a few drops of weak carbolic acid are added, until the mixture becomes of an amethyst-blue colour. The addition of lactic acid will cause a canary-yellow precipitate, even when the acid only exists in the proportion of 0·005 per cent. Care must be taken, however, to eliminate any phosphates or sugar which may be present, a task most easily performed by extracting the lactic acid with ether, and evaporating the ethereal solution. Butyric and acetic acids are detected by their odour, and by the fact that the former exhibits the characteristic oil drops on evaporation, while the latter strikes a blood-red colour with perchloride of iron.

(3) In order to estimate the *quantity of free hydrochloric acid* in the gastric juice, a definite quantity of the filtrate must be triturated with normal caustic soda till neutralisation is accomplished. A graduated burette is filled with a decinormal (1 in 10 normal) solution of soda, and 10 c.c. of the filtrate placed in a porcelain dish with a piece of red litmus-paper. The soda solution is then cautiously allowed to fall drop by drop into the porcelain dish, the contents of which are constantly stirred with a glass rod, until the litmus-paper becomes of a violet tint. The tap of the burette is then turned, and the number of cubic centimetres of the soda solution required to neutralise the mixture read off. The acidity of the gastric juice is stated in percentages of the soda solution; thus 50 per cent. acidity indicates that 50 c.c. of the soda solution has been required to neutralise 100 c.c. of the filtrate. But if we know beforehand that the acidity of the gastric contents was solely due to hydrochloric acid, acid salts being absent, and any

actic acid having been removed by ether, hen the amount of free hydrochloric acid may be calculated in the form of chlorides. It is known that 1 c.c. of the decinormal solution of soda is equivalent to 0·003646 chlorides, so that it is only necessary to multiply the number of cubic centimetres of soda solution used during the experiment by 0·3646 to obtain the percentage of free acid n the solution.

By means of a method introduced by Sjoquist and Salkowski, the exact quantity of combined as well as free acid can be estimated. To a definite quantity of the filtered gastric contents, carbonate of barium is added, in order to convert all the hydrochloric acid into chloride of barium. The chloride is separated from the excess of carbonate by means of hot water, and then converted into the insoluble barium carbonate by means of carbonate of sodium. The precipitate is collected, washed and dried, and reconverted into barium chloride by hydrochloric acid. The excess of acid is now got rid of by evaporation to dryness, and the residue is dissolved in water and triturated with a solution of bichromate of potassium and nitrate of silver, the strength of the latter being such that 1 c.c. = 0·001 NaCl. The quantity of hydrochloric acid is then calculated by the formula $x : y$ (quantity of silver chloride) : : 36·5 : 58·5.

Diagnosis. — In the earlier stages, and before the existence of ulceration, gastric cancer may be readily overlooked. We are apt to consider a person who complains of pain at the epigastrium, flatulence, and other symptoms of indigestion, as merely suffering from dyspepsia. The loss of appetite is, however, generally a more prominent symptom in the early stages of cancer than in dyspepsia, and if the patient be a person of middle age, and is rapidly losing flesh, the progress of the case should be most narrowly watched, and the abdomen frequently explored for any appearance of tumour. The chief difficulty in diagnosis is to distinguish cancer from simple ulcer; and it is often requisite to watch the case for some time before a decided opinion can be formed. As a general rule, the pain is more severe, more increased by food, and more relieved by vomiting in cases of ulcer than of cancer. On the other hand, it is less fixed to one spot, and is more neuralgic in cancer. The vomiting is more immediately after food when the cardiac orifice, and is longer delayed when the pylorus, is affected by cancer than in cases of simple ulcer. The fluids rejected in chronic ulcer contain no fragments of mucous membrane, although these may be present in acute cases, and the rejected matters do not solidify when boiled with liquor potassæ, as they sometimes do in cancer. Severe hæmatemesis should lead us to suspect ulcer, frequent 'coffee-ground' vomit incline us to the diagnosis of cancer. Loss of flesh and strength, although present in both cases, is much more rapid and decided in cases of cancer; and, in like manner, where we can find no evidence of hæmorrhage from any organ, great pallor of the lips and throat should lead us to suspect it. Again, as cancer seldom appears in those below thirty-five years of age, and quickly destroys life, we should decide in favour of simple ulcer if the symptoms occurred in a young person, and had lasted for many years. The presence of a tumour, in case proper precautions have been used to prevent mistakes on this point, will settle the question in favour of cancer The duration of the disease is an important consideration in the diagnosis, as a simple ulcer may be present for many years, with occasional partial or complete cessation of its symptoms, whereas cancer usually runs its course rapidly, without any amelioration being effected by treatment. When hard nodules on the skin of the abdomen, or enlarged glands of the navel, neck, or axillæ, can be discovered, the probability is strongly in favour of cancer; and the same may be said if jaundice, ascites, or tumours of the peritoneum present themselves.

Although the late Dr. Golding Bird had previously made known the fact that free hydrochloric acid was sometimes absent from the gastric secretion in cases of carcinoma of the stomach, the subject attracted no attention until the publication of some researches by van der Velden. According to this observer, cancer of the stomach is always associated with an absence of free hydrochloric acid; and this statement was at once accepted as a valuable help in the diagnosis of the disease in question. But further and more exact investigations soon brought to light two important facts: firstly, that free hydrochloric acid *was* present in some cases of carcinoma of the stomach; and, secondly, that the tests which were relied upon for detection of the acid often proved fallacious, inasmuch as many of the albuminous products of digestion (albumoses, peptones, &c.) are very prone to form a loose combination with free hydrochloric acid, and completely obscure its ordinary colour-reactions. Also, it is now an acknowledged fact that catarrh of the mucous membrane is often associated with a diminution in the acid secretion. There are therefore two obvious causes for the apparent absence of free hydrochloric acid in cases of carcinoma of the stomach. If catarrh is present, the secretion is diminished in amount; and if the organ is dilated, or absorption diminished from other causes, the accumulated products of digestion will effectually obscure the ordinary reactions of the acid. The whole subject may therefore be summed up as follows: the mere failure to detect free hydrochloric acid does not prove the presence of cancer; but if free acid can be easily demonstrated in a suspected case, the disease is probably not of a cancerous nature.

Prognosis.—The prognosis of any case of gastric cancer is always unfavourable. It is bad in proportion to the rapidity of the progress of the case; the early occurrence of vomiting; the frequency of hæmorrhage; and the evidence that other organs, such as the liver, are also implicated.

Treatment.—There is not much to be expected from the treatment of this disease. Inasmuch as we are unable to check the progress of the malady, all our efforts must be directed to the relief of symptoms, and to support, as well as we can, the strength of the patient. In some instances, especially where the body of the organ is affected, and where there is no ulceration of the mucous membrane, the administration of small doses of iron is beneficial. Good and well-selected food, rest, and a fair supply of stimulants, often, for a time, appear to afford new strength to those overpowered by the disease. If the body of the stomach be the part affected, the indications for treatment are the same as in simple ulcer. When the pylorus is narrowed, the same plan must be pursued as when dilatation of the stomach has occurred from any other cause. Obstruction at the cardiac orifice often brings with it the greatest misery to the patient. He is tormented with hunger which he is unable to appease, and death gradually approaches by starvation. So long as nutritive enemata can be borne they should be given; and if diarrhœa be produced by them they may be combined with small doses of laudanum. In a case of this kind great relief may be temporarily afforded by passing a narrow gum-elastic tube into the stomach, and pouring through it liquid food.

The uniformly fatal termination of gastric cancer has led to the trial of various surgical measures. When the disease is limited to the immediate neighbourhood of the pylorus, and in an early stage, complete excision of the growth (pylorectomy) has been effected. Few cases, however, can be considered suitable for this operation, which from its tedious nature has proved very fatal (about 62 per cent.). In more advanced cases, where it is found impossible to remove the seat of disease, considerable relief may often be afforded by establishing an adventitious communication between the stomach and the small intestine (gastro-enterostomy). In this manner life has in some instances been considerably prolonged, about 68 per cent. having recovered from the effects of the operation.

5. **Stomach, Concretions in.**—Concretions in the stomach are composed of various indigestible substances that have been swallowed, such as hair, paper, cotton, cocoa-nut fibre, &c. They chiefly occur in idiots and lunatics. In some of the cases recorded a tumour has been observed during the life of the patient, which in one case was mistaken for a floating kidney. Concretions of this kind may give rise to perforation, but more generally they set up inflammation of the mucous membrane, followed by peritonitis.

6. **Stomach, Contraction of.**—Contraction of the stomach occasionally takes place, and the diminution in its size may be either local or general. Numerous cases are mentioned in the *post-mortem* records of the London Hospital in which the organ was puckered up by fibrous bands radiating from the cicatrix of an old ulcer; and the writers have seen considerable distortion from this cause, the coats not being much thickened. Three instances are noted in which the stomach was divided into two pouches by thickening connected with ulceration.

General contraction of the stomach arises from various conditions. When the œsophagus at its lower end or the cardiac orifice is much contracted, constant rejection of food is apt to occur, and the stomach contracts to a small size, on account of its never being distended with food. Most of such cases are due to cancerous growths, but this condition may result from a simple ulcer of the cardiac end.

An ulceration affecting the smaller curvature near its centre may draw together the orifices of the stomach, and thus produce great diminution in its capacity. This generally occurs from cancerous ulceration, but occasionally it is the result of a non-malignant ulcer.

The capacity of the stomach may be reduced by thickening of its walls. The writers have seen simple fibroid change produce in this way a great diminution in the calibre of the stomach; but usually it is the result of a malignant growth infiltrating the coats of the organ.

Contraction of the stomach may also arise from the extension of malignant disease from some of the neighbouring structures. In other cases the coats become greatly thickened, and its capacity diminished, from the effect of chronic peritonitis, either tubercular or malignant. Under such circumstances the stomach is bound down, and it is constricted by the surrounding adhesions, so that its capacity is greatly reduced.

7. **Stomach, Dilatation of.**—This may occur either in an acute or in a chronic form.

(1) **Acute dilatation.**—This form is exceedingly rare, and has attracted but little attention until of late years. The earliest case on record is that of a lady mentioned in the fourth volume of the *Transactions of the Pathological Society of London*, by Drs. Miller and Humby. She had been under treatment for piles shortly before her illness, and the abdomen had been observed to have increased in size. She was attacked

with vomiting of immense quantities of fluid. The vomiting ceased four days afterwards, and the abdomen was found to be greatly enlarged. After death the cause of the abdominal distension proved to be the stomach, which was so much dilated that it was capable of holding ten pints of liquid. The late Dr. Hughes Bennett of Edinburgh relates a similar case, and attributes the dilatation to a large quantity of effervescing liquid the patient had swallowed to allay his thirst. The late Dr. Hilton Fagge, in the *Guy's Hospital Reports* (vol. xviii. Third Series), describes two cases that had fallen under his notice, and also mentions that two similar cases had been observed at Guy's Hospital during fourteen years. Other cases have since been published by various observers confirming these accounts, so that there is no doubt that the stomach may dilate much more rapidly than was formerly supposed.

Diagnosis.—The signs of acute dilatation of the stomach, according to Dr. Fagge, are: '(1) A rapidly increasing distension of the abdomen, which is unsymmetrical, the left hypochondrium being full while the right hypochondrium is comparatively flattened. (2) The existence of a surface-marking descending obliquely towards the umbilicus from the left hypochondrium, and corresponding with the dragged-down lesser curvature of the stomach, this line appearing to descend with each inspiration. (3) The presence of fluctuation in the lower part of the abdomen. (4) The occurrence of splashing when the distended part of the abdomen is manipulated. (5) The presence of a uniformly tympanitic note over a large part of the distended region, when the patient lies flat on his back. Above the pubes, on the other hand, there may be dulness on percussion, simulating that of a distended bladder.

Treatment.—There is no doubt that the treatment recommended by Dr. Fagge is the proper one, namely, to empty the distended stomach as quickly as possible with the stomach-pump; and to maintain life by nutrient and stimulating enemata.

(2) **Chronic dilatation.**—Ætiology.—Any condition that causes the food to remain in the stomach for an undue length of time tends to produce dilatation; and thus it may be either the result of enfeebled muscular power of the organ, or of an obstruction to the passage of its contents through the pylorus. A moderate amount of dilatation is a common accompaniment of chronic gastritis and of atonic dyspepsia, as in both of these conditions there is often a diminution in the contractile power of the muscular coat. The cases in which there is extreme dilatation are generally the result of an obstruction at the pyloric orifice, retarding the passage of the digested food into the duodenum; and this may arise from various causes. 1. Malignant disease is the most common. It must not, however, be supposed that the extent of the dilatation is always in proportion to the narrowness of the stricture, for it seems in no small degree to depend on the amount of the destruction of the muscular coat by the new-growth. 2. Dilatation may be the effect of ulceration in the pyloric region, and it is often said that it arises from the narrowing of the orifice by the cicatrisation of an ulcer. According to the writers' experience, the most complete strictures of the pyloric orifice are found as the result of the healing of ulcers produced by the swallowing of corrosive liquids, but in two such cases that have come under their observation there was no dilatation, but rather a contraction of the stomach, arising probably from the incessant vomiting that was present in the later stages of the illness. 3. Three cases are mentioned in the hospital *post-mortem* records, and the writers have seen others, in which there was only fibroid thickening at the pylorus, without ulceration. Under such circumstances the exit of the food is probably delayed, partly by the narrowing of the opening, and partly by the changes in the muscular coat that generally attend fibroid degeneration. 4. The stomach may be displaced by adhesions, or the pylorus be so dragged downwards that dilatation results. 5. The organ may become dilated from paralysis of its muscular coat, produced, as in a case given by Dr. Wilks, by injury to the splanchnic nerves. 6. The pressure of tumours upon the pylorus or duodenum externally may prevent the due evacuation of the contents of the stomach. The tumours are usually of a malignant nature, but, more rarely, the same effect may arise from enlarged glands.

Anatomical Characters and Pathology. When the abdomen is laid open, the stomach is found to be greatly increased in size, often so much so that it appears to fill the whole cavity. The greater curvature lies below the umbilicus, in extreme cases even as low as the pubes. The position of the pylorus varies according to the nature of the coexisting disease. Sometimes it is tied down by adhesions to its original site; at other times it has been dragged downwards by the weight of the enlarged organ, and is situated at a much lower level. When the stomach is laid open, it is found partially or wholly filled with a dark-coloured frothy fluid, the amount of its contents being often enormous. The rugæ are effaced by the constant stretching, and the mucous membrane presents a level surface, which is generally more or less softened by the action of the acid contents upon it after death. Microscopically, the glandular structure is found to have suffered from the long-continued stretching. In some cases the tubes are visible, widely separated.

In one case the destruction had proceeded still further; a large proportion of the tubes had been destroyed, and were replaced by fibrous tissue, the muscular tissue being also thin and fibrous. In other instances the muscular structure proves to be in a state of hypertrophy, this condition being usually most distinct in the pyloric region.

Symptoms.—As, with the rare exceptions before noticed, where the dilatation occurs suddenly, the stomach only slowly enlarges, the symptoms manifest themselves very gradually. They are preceded by those of the malady which gave rise to the dilatation. Thus, the patient may for many years have suffered from the severe pain after food and vomiting indicative of ulceration; or frequent attacks of waterbrash, or flatulence and acidity, may have led to the suspicion of fibroid degeneration of the pylorus. Unless cancer should co-exist, there is seldom much complaint of pain, but a sensation of weight and fulness is usually experienced. More generally, attacks of heartburn present themselves, and a scalded feeling of the stomach and œsophagus annoys the patient. In some, there is a constant sense of craving referred to the epigastrium. Vomiting is almost always present, although it may be absent for considerable intervals. It does not occur, as in gastric ulcer, shortly after food, nor is there usually any complaint of nausea. The patient feels full and uncomfortable, and often has a sensation as if fermentation were going on in the abdomen for two or three days, until he gets relief by the evacuation from the stomach of an enormous quantity of liquid. In other cases, the vomiting occurs more frequently, generally at night, or towards the morning. He experiences great relief for a few hours or days, as the case may be, until the fluid again collects in sufficient quantity to produce discomfort. There is no great amount of straining during the attacks of vomiting, and if the abdomen be examined as soon as the act is terminated, the stomach is still found to contain fluid. It seems, indeed, as if the contents were only partially pumped off by the action of the diaphragm and the abdominal muscles, the stomach itself being quite passive. In some cases hæmatemesis occurs, but this is rare, unless cancer be also present. The characters of the vomited matters are peculiar; usually they are of a more or less dark brown colour, very sour, edging the teeth and scalding the throat of the patient. When the liquid is allowed to stand, it soon becomes covered with a thick scum, and deposits a thick brown sediment. Chemically, it is found to contain various acids produced by the decomposition of the food. Microscopically, we meet with sarcinæ and torulæ in great abundance, intermixed with particles of partially digested food, and with mucus. In a few cases bile is evacuated, but this is an uncommon circumstance, especially where there is a narrow stricture at the pylorus. Acid eructations are very common, and often more distressing to the patient than any other symptom. Thirst is usually complained of, and an excessive secretion of saliva is frequently remarked. The tongue presents nothing characteristic. The appetite is bad where cancer co-exists, but in other cases it is good, often voracious. The bowels are almost always constipated, and the stools hard and knotty. The urine is usually acid, and often deposits an abundant sediment of lithates. The nutrition of the patient soon suffers, and loss of flesh and strength always accompanies the disease. In some rare instances severe attacks of tetanic spasms of the extremities occur, attended with great faintness and exhaustion. Death not infrequently results, but in one case the writers have known the spasms gradually subside and the patient recover. Some pathologists have supposed these attacks to arise from the dryness of the tissues resulting from the imperfect absorption of water, whilst others have attributed them to the absorption from the stomach of some of the products of the decomposition of the substances contained in it. In dilatation of the stomach death usually takes place from exhaustion, and is not infrequently preceded by œdema of the feet and legs.

Physical Signs.—The abdomen is perhaps distended, and covered with enlarged and tortuous veins. The shape is characteristic, the upper curvature of the stomach being visible as it stretches across between the false ribs, the epigastrium being hollow instead of prominent, and the abdomen much fuller on the left than on the right side. When the muscular coat is in a state of hypertrophy, the vermicular movements may be seen through the stretched and attenuated integuments. The movements are slow and gradual, proceeding usually towards the right side of the body. They are almost constant, but can be quickened by the application of cold or by galvanism. Too great stress must not be laid upon this symptom. Whenever any portion of the gastro-intestinal tube is contracted, vermicular movements are visible in the parts above the stricture. The sounds on percussion vary as the dilated stomach is full of air or of fluid. The tympanitic sound is best heard when it is only partially full. By changing the position of the patient, we are enabled to show that the fluid gravitates in the enormously dilated organ. By lowering the head and raising the hips and legs, we may generally define the lower boundary of the stomach, by the clear sound which is thus exchanged for a dull one on percussion. Bamberger asserts that, by placing the stethoscope over the stomach whilst the patient is drinking, we can hear the fluid fall into the distended cavity. This, in the writers' opinion, is of little value, for they have distinctly heard the passage of food through a stricture of the cardiac opening where the stomach was smaller than normal.

Where there is a difficulty in determining dilatation of the stomach, the patient should take a slight meal in the evening, and on the following morning, whilst he is fasting, a stomach-tube should be introduced, and any material that may have remained in the organ should be removed and examined with the microscope. If a considerable quantity of food remains after twelve hours' fasting, there can be no doubt as to the dilatation.

Certain methods have been lately proposed to test more accurately the motor powers of the stomach. Klemperer introduces a given quantity (100 grammes) of olive-oil into the empty organ by means of a tube, and, after allowing it to remain a certain length of time, withdraws it again and measures the residue. He finds that, in healthy persons, after the lapse of two hours, 70 or 80 per cent. of the oil has usually been expelled into the duodenum, and only about 20 per cent. therefore can be recovered. But where the muscular wall is atonic and the organ dilated, only 25–50 per cent. is got rid of in the same time. This method is uncertain in its results, and exceedingly distasteful to the patient.

Ewald has proposed a method which depends on the fact that salol is not absorbed or altered by its residence in the stomach, but that on reaching the duodenum it is immediately converted into salicylic acid, and is excreted by the kidney. He accordingly administers this salt by the mouth, and tests the urine at intervals with perchloride of iron; and finds that, under normal conditions, the characteristic purple reaction takes place in thirty to sixty minutes, but in cases of gastric enfeeblement the period which elapses is very much longer. Huber has modified the method, and made it of more practical value. He finds that, after giving one gramme of salol to a normal individual, the kidney has excreted all the salicylic acid within twenty-four hours; but, if the stomach fails to pass on the salol with the normal rapidity, excretion will commence later and last longer, and hence the urine will still contain salicylic acid at the end of thirty hours. This extended time of reaction indicates gastric enfeeblement and dilatation.

DIAGNOSIS.—With ordinary care, a dilated stomach is not likely to be confounded with any other abdominal disease. The chief points to bear in mind are—the large extent over which there is a tympanitic sound; the irregular distension of the abdomen; the hollowness of the epigastric region; the fulness of the left side of the abdomen; the vermicular motion apparent over the dilated organ; the peculiarity of the vomiting; and the large amount of fluid thus evacuated of an acid character, presenting under the microscope torulæ, sarcinæ, and bacilli.

Whenever there is any difficulty, the stomach-tube should be introduced after the patient has abstained from food for twelve hours, and any materials that remain should be removed and examined with the microscope. The practitioner should bear in mind that dilated stomach is not infrequently met with along with an old ulcer of the pyloric region. The diagnosis of the cause of the dilatation must be determined by the history of the case.

TREATMENT.—The first and most important indications are to remove from the stomach the mass of decomposing materials contained in it, and to cleanse the mucous membrane from the mucus and other substances tending to set up fermentation in any food that may be taken. This is most readily effected by the introduction of a tube, through which the contents of the organ may be evacuated, and water or solutions of different substances may be introduced. Formerly a stiff stomach-tube was invariably used, and the contents of the organ removed by the action of a pump; but of late years a much easier and less dangerous procedure has been employed. *See* LAVAGE.

By means of this rational method of treatment the greatest success has been attained during late years in cases of gastric dilatation; and even when the pylorus is rendered impassable by cancerous disease, it is wonderful what a beneficial effect the periodical emptying and cleansing of the dilated organ can exert upon the general welfare of the patient. In many cases which have come under the writers' notice, the patients began to improve immediately the stomach-tube was brought into use, and not only gained flesh and strength, but lived for many months after the cancerous disease had appeared to have reached a fatal stage. But unfortunately there is always a tendency to overrate the value of any therapeutic measure, and consequently to lose sight of the indications for its employment in an ill-advised attempt to extend its sphere of usefulness. Consequently it has happened that many practitioners have tried to introduce lavage into the treatment of every disease where the stomach has appeared at all at fault; and have proclaimed the method as the true panacea for all gastric ills. Atonic dyspepsia, anæmia, the crises of ataxia, and even acute catarrh of the stomach, have all been subjected to the gastric douche, while the products of digestion have been withdrawn and examined in nearly every disease where it has been possible to pass a tube. But, apart from the fact that such indiscriminate application has proved of no practical value, either in diagnosis or treatment, it must always be remembered that the use of the stomach-tube is not totally devoid of danger. While it may be said that lavage is an invaluable remedy in cases of dilatation of the stomach and chronic catarrh, its indiscriminate employment in every case of disordered digestion will prove an injury rather than a benefit, and will eventually throw discredit upon the whole method of treatment.

Some writers recommend the administration of small doses of diluted hydrochloric acid after each meal to assist digestion, but the writers have seldom seen it of much use. Where cancer is absent moderate doses of cod-liver oil appear of service, but in other cases the drug is apt to produce nausea and loss of appetite. The muscular action of the stomach must be as much as possible assisted; and a well-fitting bandage, or an abdominal belt, is often of value. Electricity has been strongly recommended by some, but in the experience of the writers it is rarely productive of benefit. What, however, is always more or less beneficial is to keep up a free action on the large intestine by mild aperients or enemata. Injections of gruel and barley-water, mixed with castor-oil and turpentine, answer the purpose best.

Symptoms must be relieved as they arise. Subcutaneous injections of morphine are invaluable for the relief of pain. In some cases chloral hydrate answers better, but, on the whole, it is inferior to preparations of opium. One of the most distressing symptoms is acidity. This is best relieved by a combination of bismuth with magnesia or soda, or by lime-water given frequently. Sir William Jenner recommended the hyposulphite of sodium to relieve the acidity. Others have prescribed carbolic acid and creasote.

As regards the diet of the patient, such articles of food should be chosen as are least liable to ferment, and consequently starch and saccharine substances should be as far as possible excluded. Where there is much pain after food, or other symptoms of ulceration, it will be found best to restrict the patient to liquid food, taken frequently and in small quantities, such as milk, meat-juice, chicken-broth, and beef-tea. But where there is not much pain, frequent small meals of solids may be allowed, consisting of soft-boiled eggs, fish, fowls, tripe, sweetbread, &c. When the vomiting persists in spite of the use of the stomach-tube, nutrient enemata should be used. Alcohol seldom agrees; but, if it seems to be necessary, small quantities of brandy or whisky will be found to answer better than wine.

The operative treatment for cicatricial contraction of the pyloric orifice was first advocated by Loreta. The organ is opened in the neighbourhood of the lesion, and the pylorus forcibly stretched, either by the finger of the operator or by means of a mechanical dilator. Among twenty-seven recorded cases collected by the writers, ten died soon after the operation, while the remaining seventeen recovered, and several remained free from their previous symptoms for some months afterwards. In one instance the operation was performed twice. In one unpublished case which has come under the writers' notice, the forcible stretching of the pylorus caused rupture of the orifice, and also of the first inch of the duodenum, the patient dying of acute peritonitis. The writers would therefore advise that in every case a careful trial of medicinal and dietetic treatment be made before surgical interference is undertaken.

8. **Stomach, Fibroid Thickening of.** This condition has received various names, such as 'cirrhosis of the stomach,' 'sclerosis,' 'plastic linitis,' &c. Allusion has been made in another article to thickening of the coats of the stomach of a similar nature to that affecting the pylorus, and usually producing hypertrophy of the muscular layer, narrowing of the opening into the duodenum, and eventually dilatation of the organ (*see* PYLORUS, Diseases of). Such cases, although not common, are every now and then met with, and in many instances the thickening of the submucous tissue extends for some distance from the pylorus, producing a tough, leathery condition of the coats. More rarely the thickening occurs in other parts than at the pyloric end. But, apart from these local thickenings, we occasionally meet with a form of the disease in which the coats of the whole organ are immensely hypertrophied.

ÆTIOLOGY.—Males seem to be more liable to this complaint than females, and it occurs at an earlier period of life than cancer. Dr. Brinton states that, whilst the average age of cancer is fifty, that of fibroid thickening is only thirty-four. Mechanical injury seems in some instances to have produced this disease.

ANATOMICAL CHARACTERS.—On opening the abdomen, there are almost always found signs of general peritonitis, either acute or chronic. In some cases a thick layer of lymph overlies and unites the various organs; in other cases only fluid, mixed with flakes of lymph, is discovered. The stomach is round or oval in shape, smooth on the surface, firm to the touch, often forming a tumour in the epigastric or hypochondriac region. When cut into, its walls do not collapse; and its cavity is often so much reduced in size as to be capable of containing only a few ounces of fluid. The thickness of the walls varies greatly, but in some instances it has been described as upwards of an inch. As a general rule, the walls are thicker at the pylorus than elsewhere, but the opening into the duodenum is not necessarily constricted, although such is not infrequently the case. The coats are of a dirty-grey colour, but the distinction between them can be readily made out. The chief seat of the thickening seems to be in the submucous tissue; but the muscular layers, as well as the connective tissue between the muscular bundles, and the subserous structure, are all much increased in thickness and density. The mucous membrane is thrown into folds or elevations, or studded over by small projections, most of these appearances being probably the result of the diminished capacity of the organ; it may also be ulcerated. Microscopically, the mucous membrane is usually found to be healthy.

SYMPTOMS.—In a case observed by the writers the symptoms followed immediately after the receipt of an injury to the epigastrium; but usually they have come on insidiously. There is generally pain in the epigastrium, increased by food, in some instances shooting into the back and shoulders. The tumour formed by the thickened stomach is almost always tender on pressure, but not remarkably so, unless peritonitis is present. Vomiting is a general symptom; in some instances it occurs directly after food, in others the fluid rejected is thin, like saliva. Towards the close of the disease vomiting of blood is not infrequent; but, unless ulceration occur, there is an absence of the coffee-ground fluid so constantly marked in cancer. The appetite is always bad, and decreases as the disease advances; the bowels are usually confined. There is loss of flesh and strength. The pulse is feeble towards the end of the case. Dropsy, both of the peritoneum and lower extremities, generally shows itself; and the patient dies from exhaustion, or is cut off by the occurrence of peritonitis. The duration of the malady varies greatly. In some cases it has been known to last for many years, whilst in others the patient has died in a few months.

Physical Signs.—In almost every instance a tumour has been observed during life. It is generally situated in the epigastrium, but may present itself in either hypochondrium. In one patient it was supposed, from its situation, to be a cancer of the spleen. It is smooth upon the surface, more or less tender to the touch, and usually movable from side to side. On percussion, the sound is not perfectly dull, as in the case of a solid tumour.

DIAGNOSIS.—This complaint may be confounded with cancer, or with foreign bodies in the stomach. It must be most difficult, if not impossible, to diagnose the more acute cases from cancer. The smoother surface of the tumour, and the non-affection of the liver or other organs, are the most likely points on which stress may be laid, to distinguish between the two diseases. In the chronic cases of fibroid thickening, the long duration of the illness, the less constant pain, the vomiting directly after food, the less frequent occurrence of coffee-ground vomiting, and the absence of the history of a family predisposition to cancer, may afford some grounds for a diagnosis. To distinguish these cases from foreign bodies in the stomach, we must remember that the latter are found chiefly in idiots and in the insane, or in hysterical females. One of the writers has long been in the habit of distending the stomach in all doubtful cases, by making the patient drink freely of soda water; and in one instance where the coats of the stomach were much thickened, he succeeded by so doing in proving the case to be one of fibroid disease. The note on percussion became more tympanitic, and the lump descended, but in the case of a foreign body in the stomach no change would be effected by such a manœuvre.

TREATMENT.—Careful attention to diet is the most essential point in the treatment of this disease. The diminution in the size of the stomach is sufficient to show that only small quantities of food can be retained, and the impaired condition of the motor apparatus indicates the necessity that the nourishment should consist only of liquids. Milk and animal soups seem best fitted for such cases. Opium is almost the only medicine likely to be of value. Occasional leeches, and small blisters, frequently repeated, to the epigastrium, tend to relieve the sufferings of the patient.

9. **Stomach, Gangrene of.**—It is supposed by many modern authors that ulcerations of the stomach are produced by the solution, by means of the gastric juice, of small patches of the mucous membrane that have been deprived of their vitality, and become gangrenous. Such may no doubt be the case when the morbid condition is confined to merely isolated patches of the stomach; but where general acute gastritis co-exists there is often a complete suspension of the secretion of gastric juice, and in many such cases the edges of the sloughing tissues may be seen still attached to the neighbouring healthy structures. Where there has been great depression of strength, we occasionally meet with sloughing, to a considerable extent, of the mucous membrane of the stomach, both in the inferior animals and in man. Cases of sloughing of the stomach occurring in the human subject have been recorded by various writers. A case is mentioned in the records of the London Hospital in which sloughing of the cardiac end of the stomach was found in a woman fifty-two years of age, but it was associated with ulceration of the ascending colon, and there was also sloughing of the left lobe of the liver and suppuration of the left kidney. The late Dr. Habershon also mentions one in which, along with diseased kidneys and pneumonia, there were several sloughs at the lesser curvature of the stomach. The most ordinary form of gangrene of the stomach is where it occurs in cancer of the organ. A large mass of sloughing tissue is found connected with a malignant ulceration, often of large size,

and generally situated towards the pyloric end of the organ.

Treatment.—Gangrene of the stomach is beyond treatment other than what may be afforded by opium or perhaps some simple antiseptic.

10. **Stomach, Hernia of.** — *See* 15. Malposition.

11. **Stomach, Hyperæmia of.**—The mucous membrane of the stomach is frequently found to be congested after death, where there has been but little evidence of disease during life.

Ætiology and Anatomical Characters. Gastric hyperæmia may arise from different causes. If an animal be killed when fasting, the lining membrane of the stomach is found to be pale and anæmic; but if death should occur whilst digestion is going on, the vessels are seen to be filled with blood. The same observation is made in the human subject, and serves to explain the frequent occurrence of a congested state of this organ after death. In other instances the increased vascularity is the result of a lavish employment of alcoholic stimulants during the later hours of life. The most extreme degrees of hyperæmia of the stomach are met with in cases of diseased heart, more especially when the mitral valve has been constricted. When we open the stomach we are at once struck with the dark purple condition of its lining membrane, the appearance of congestion being most evident in the pyloric region, and terminating abruptly at the end of the œsophagus. The rugæ seem thick and prominent, and the whole surface is covered with a layer of tenacious mucus. Spots of extravasated blood present themselves, some being softened on their surface, as though they had been acted upon by the gastric juice. There is seldom, however, any of the general softening characteristic of the action of the gastric juice after death, and the surface looks raw and uneven after the removal of the adherent mucus. The whole stomach has a thickened, fleshy feeling, and is, in reality, considerably increased in bulk. Microscopically, sections of the stomach have an opaque appearance, from the quantity of blood and serum they contain, but after being for some time macerated they become more transparent. In some cases the tubes can be readily separated from each other, and are normal; in other cases they are of unusually large size, and distended with cells and granular matter. The blood-vessels are always enlarged, and in long-standing cases the coats of the veins are thickened. The capillaries surrounding the orifices of the tubes are especially dilated and engorged with blood. Long-continued congestion reduces the secretion of the stomach. The secretion of acid is evidently lessened, for in some instances phosphates have been found in the contents of the stomach, and, as a general rule, the mucous membrane does not present the appearance of *post-mortem* solution. The formation of pepsin is also impaired. The question may be asked, why hyperæmia is more intense in the pyloric than in the more actively secreting portions of the organ. In all probability it arises from the fact that the vessels of the stomach perforate the muscular coat obliquely before they pass upwards between the tubes to the surface. The circular fibres must compress these vessels during their contraction; and the veins, from the greater weakness of their coats, and from their being less protected by surrounding fibrous tissue, must feel the effects of the compression more than the arteries. The transverse muscular fibres are comparatively thin and weak in the larger portion of the stomach, and become firmer and stronger as we approach the pylorus. Consequently the veins are more liable to compression during the more energetic motions of this region, and the effects of the congestion are here more appreciable.

12. **Stomach, Hypertrophy of the Walls of.**—*See* 8. Fibroid Thickening.

13. **Stomach, Inflammation of.**—Synon.: Gastritis; Fr. *Gastrite*; Ger. *Gastritis.*

All the coats of the stomach may be simultaneously inflamed, but this is rarely met with (*see* 8. Fibroid Thickening). Usually the mucous membrane is alone the seat of the disease, and it has of late years been the custom to describe this as 'gastric catarrh.' This term is objectionable, as catarrh is so generally applied to the inflammation of mucous membranes of a much more simple anatomical structure. It should be borne in mind that the mucous membrane of the stomach is in reality an expanded gland, the elements of which have a greater functional activity than those of any other secreting structure in the human body. The injuries inflicted upon it by disease are therefore in no way analogous to those suffered by an ordinary lining membrane, but tend to lessen or altogether destroy the function of an organ of primary importance to the well-being of the individual. In addition to this, the anatomical changes are not always of the same character, but seem to the writers in certain cases quite distinct from those ordinarily produced by catarrh. Inflammation of the mucous membrane of the stomach will therefore be described under two forms, namely, (1) *Catarrhal*; and (2) *Erythematous gastritis.* It will be also necessary to consider the disease according as it occurs in an *acute* or *chronic* form.

(1) **Acute Inflammation—Acute Gastritis.**—Ætiology.—Acute *catarrhal gastritis* is most common in persons of middle and advanced age, and more frequently affects females than males. Sometimes it occurs in gouty and rheumatic subjects, and

is relieved when the disease appears in the joints. Again, it presents itself in those who suffer from disease of the heart, emphysema of the lungs, cirrhosis of the liver, and other disorders that have a tendency to keep up a congested condition of the digestive tract. Under these circumstances it often proves dangerous, and snaps the feeble thread by which the patient clings to life. The most common exciting causes of acute gastritis are errors in diet; various indigestible substances, such as cheese or shell-fish, being especially liable to produce it. Above all, an immoderate indulgence in spirituous liquors is apt to set up this form of inflammation, not infrequently laying thereby the foundation for other and more serious morbid changes.

Acute *erythematous gastritis* is more generally met with in children and in young persons, and constitutes a considerable number of the so-called 'gastric' and 'remittent' fevers so common at this period of life. It also presents itself in scarlet fever and other eruptive disorders; and although it usually passes off without provoking any local symptoms during the fever, it nevertheless constantly leaves a liability to a frequent recurrence of the disorder. Considering how often the recurrence takes place, it is strange that so little attention has been attached to the circumstance. A similar morbid condition of the stomach often makes its appearance in the last stage of phthisis and other exhausting disorders, and adds greatly to the danger and sufferings of the patient.

Anatomical Characters.—In *catarrhal gastritis* the stomach is usually contracted and empty. The lining membrane is covered with a tenacious or thready mucus, beneath which it appears irregularly congested. It is softer than usual; and often presents numerous small hæmorrhages. These are most commonly met with in the pyloric region, are round or oval in shape, and frequently superficially ulcerated. Microscopically, the pits on the surface of the membrane are found to be swollen, prominent, and their vessels much congested. On section, the gastric tubes are seen to be greatly distended with large granular cells, which, by their increased size and number, bulge outward the basement-membrane, so as to produce an irregular outline. The solitary glands are generally enlarged.

We meet with the most perfect examples of acute *erythematous gastritis* in scarlatina. In the earlier stages there is no increased secretion of mucus, and often but slight injection of the surface, whilst at a later period the mucous membrane may be even paler than usual. Microscopically, the gastric tubes are much distended by granular and fatty matters, so that the cells are quite obscured, and in many cases these seem to be reduced greatly in number. Casts of the tubes are in some instances met with in the contents of the stomach. It will be observed that the morbid appearances, which are strictly analogous to those of the skin in scarlatina, differ from those produced by catarrh, in the amount of mucus not being increased, and in the tubes being distended by an albuminous fluid, instead of by an increased growth of the cells themselves. It is therefore analogous to an erythematous affection of the skin, with which, indeed, it is associated in scarlatina; whilst the catarrhal form is analogous to the eczematous and other inflammations of the cutis, which are characterised by a more abundant formation of the cellular elements.

Symptoms.—The *catarrhal* form of gastritis is sometimes preceded for a few days or hours by a feeling of general weakness; in other cases the attack comes on without warning. There is seldom any complaint of pain in the region of the stomach, although a sense of fulness and uneasiness is not uncommon. Nausea or vomiting is usually present, and in nervous subjects is often very distressing; it constitutes one of the most characteristic signs of the disease. Tenderness on pressure is rarely absent. At first the remains of the previous meal are rejected, but afterwards a thick, glairy mucus is expelled, attended with violent retching. The tongue is foul, and the breath often offensive, from the co-existence of oral catarrh. There is an absence of appetite, or a positive aversion to all food. The bowels are confined; the urine, which is often pale and copious before the attack, becomes scanty and high-coloured during its continuance. The pulse is rarely quickened, and the temperature of the skin is unaltered. There is almost always headache, the pain chiefly affecting the forehead and eyes, and being accompanied by intolerance of light and sound, whilst sleeplessness forms a prominent symptom in many cases.

In *erythematous* gastritis, on the contrary, pain at the epigastrium is a prominent symptom, excepting when the disease accompanies eruptive fevers. It usually comes on directly after food, sometimes shooting towards the shoulders, or down the left arm. In phthisical cases a feeling of rawness in the œsophagus and stomach is more generally complained of. The pain is associated with tenderness on pressure over the pit of the stomach. In children there is usually an absence of pain, but the tenderness is well-marked. Vomiting is as general as in the catarrhal form, but the matters rejected seldom contain much mucus. Nausea is present where vomiting is absent, and in the slighter cases forms the chief ground of complaint. Thirst is almost always troublesome. The tongue is at first red and injected, but in a day or two it is apt to become dry and glazed. Diarrhœa generally accompanies the disease, the stools being fœtid and unhealthy. The pulse is frequent, often out of all proportion to the severity of the other symptoms. The temperature of the skin is increased, especially in children.

Both these forms of gastritis generally subside, but in other cases the disease shows a tendency to become chronic. In both there is a diminution, or entire cessation, of the secretion of the stomach. This does not arise from any deficiency in the amount of pepsin in the tubes, for the writers have found the mucous membrane after death capable of forming an active artificial gastric juice. In all probability, the secretion of acid is arrested, or its flow into the stomach prevented, by the swelling of the orifices of the tubes or of the pits into which they open. The result, however, is that fermentation occurs in any food taken; the inflammation is thereby kept up; and large quantities of torulæ, mixed with food or mucus, are rejected by vomiting.

Diagnosis.—The vomiting of acute catarrhal gastritis, attended, as it so frequently is, by headache, is apt to be confounded with the gastric irritability of brain-disease. In affections of the brain the vomiting occurs more directly after food, and is often unattended by nausea. The tongue may be clean, whilst the pulse is quick, the skin hot, the bowels obstinately confined, and other symptoms are present pointing to some brain-lesion. In gastritis nausea is more complained of; the tongue is foul; the pulse, in the catarrhal form, but little quickened; the skin comparatively cool; the bowels often relaxed; and there is a history of previous attacks, or of some dietetic error or co-existing visceral disorder. Acute erythematous gastritis may at first closely simulate typhoid fever, especially in children. It is, however, distinguished from it by the gastric symptoms being prominent from the onset; by their sudden occurrence; by the rapid, not gradual, rise of the temperature; by the red, injected tongue; and by the spleen not being enlarged. The fall in the temperature, and the absence of eruption and of diarrhœa, serve to prevent mistakes after the first week of the illness.

Prognosis.—When gastritis is uncomplicated, the prognosis is favourable, but it is otherwise if it take place in the course of some serious chronic disorder.

Treatment.—The general principle to be kept in view is to afford the stomach as perfect physiological rest as possible. In severe cases, therefore, it is best to let the patient abstain entirely from all food for twenty-four or forty-eight hours, allowing him to suck only a little ice, in order to allay thirst. If there be much exhaustion, or if the attack be a protracted one, the strength may be supported by nutrient enemata. Sometimes the subcutaneous injection of morphine assists in giving rest to the inflamed organ. In acute catarrhal gastritis, especially when it is attended with portal congestion, or has arisen from excessive indulgence in spirituous liquors, we can often put a stop to the attack by calomel. From two to five grains may be placed on the tongue, and be followed by a saline aperient, and a second dose may be administered the following day. When there is diarrhœa or much exhaustion, it is a good plan to give a grain every few hours. In the slighter attacks effervescing liquids often give great relief to the patient. In the earlier stage of erythematous gastritis, nitrate of potassium or chloride of ammonium, along with diluted hydrocyanic acid, is generally of benefit; the bowels being at the same time relieved by some mild aperient, or by an enema.

In both forms the practitioner should be on the watch lest the symptoms should be kept up by fermentation. This is readily determined by placing a drop of the vomited matters, mixed with a weak solution of iodine, under the microscope; or by testing for lactic, acetic, and butyric acids. Torulæ, if present, will be detected by their brown colour, round or oval shape, and their tendency to the formation of chains of cells. In case of fermentation, carbolic acid, creasote, or sulphurous acid may be prescribed. The glycerine of carbolic acid, in does of ten or twelve drops, is to be preferred, combined with tincture of belladonna or solution of morphine.

Occasionally the vomiting appears to persist from exhaustion. When this is suspected to be the case, stimulants must be had recourse to; and in many instances champagne will stop sickness at once, when all other remedies have been fruitlessly tried. It is in such circumstances that the hypodermic use of morphine is so valuable; a single dose often giving sleep, and allowing the stomach sufficient repose to recover its normal tone.

When there is much epigastric tenderness, the application of a few leeches is often of great value. This is chiefly the case where the attack has occurred as a complication of some other gastric disorder, such as ulcer. In obstinate cases of catarrhal gastritis, dry-cupping may be used with benefit. In the erythematous form the writers always find warm external applications useful, such as poultices of linseed meal, with or without mustard, hot fomentations, and in some cases stimulant or opiate liniments.

As soon as it is considered advisable to allow food, it should be given in the liquid form; in small quantities at a time; and often repeated. In catarrhal gastritis all saccharine and starchy fluids should be avoided. It is best to restrict the patient to chicken-broth, or mutton or beef tea, or milk mixed with soda, Vichy, or Seltzer water. In the erythematous form, where there is less tendency to fermentation, barley-water, arrowroot, or other farinaceous food mixed with milk may be used. It often happens that condensed or peptonised milk is tolerated where cow's milk is rejected.

(2) **Chronic Inflammation.**—SYNON.: Chronic Gastritis.

This is, perhaps, the most common disease met with in practice, and comprises all the forms of chronic gastric derangement usually described under the head of 'inflammatory dyspepsia.' It is almost always of a catarrhal nature; for when signs of erythematous gastritis present themselves, it will generally be found that the latter affection is an acute attack supervening on chronic changes of a catarrhal nature.

ÆTIOLOGY.—Males are more subject to chronic gastritis than females; and amongst the working classes the writers found it was most frequent in men between forty and fifty, and in women between fifty and sixty. In a large proportion of the cases that occur in early life it is an hereditary disease, and the mother is much more apt to transmit it than the father. It often results from attacks of acute inflammation. Persons of a full habit of body are more especially liable to chronic gastritis, and it is in such that the complaint usually proves especially rebellious to treatment. Of all causes, errors in diet are most apt both to induce it, and to maintain it when once it has been lighted up. Thus, a too free supply of animal food is one of the most potent causes; and equally so is the habit of too frequent repetition of meals, without allowing a sufficient interval between them. This habit of eating too frequently is greatly kept up by the craving which is so common a symptom of the disease. Imperfect mastication is another common cause; but, above all, the immoderate use of alcohol occupies a prominent place. It is strange how frequently we discover signs of chronic gastritis after death, where no particular complaint has been made of any derangement of the digestive organs. This is more especially the case where cirrhosis, chronic congestion of the liver, diseased heart, and other disorders tending to obstruct the portal circulation, are present. In like manner, it is apt to occur whenever any excretory organ is performing its office imperfectly, as in chronic diseases of the kidney, or when constipation or inactivity of the skin exists. It is very common in gouty subjects, and in females who suffer from catamenial derangements; and it is often met with in persons who have died of phthisis and other wasting disorders.

ANATOMICAL CHARACTERS.—The mucous membrane of the stomach is covered with a layer of greyish white, tough, transparent mucus, which firmly adheres to the surface. On its removal, an abnormal amount of vascularity becomes apparent, the veins being large and prominent. The surface is often of a grey or slate colour, and not infrequently numerous hæmorrhagic erosions present themselves. This is more especially the case where long-continued congestion has been kept up by cardiac or hepatic disease. In other cases the surface is strikingly uneven, being studded over with numerous little prominences, separated from each other by shallow furrows. This condition is named 'mammillation.' More rarely, small polypoid formations project from the membrane. The whole membrane is firm and tough, and can be stripped away from the subjacent structures in flakes of considerable size. These anatomical changes are more common in the pyloric region than in the more actively secreting portions of the organ.

Microscopically, in the slighter cases the anatomical changes may be limited to enlargement and thickening of the small pits on the surface, together with dilatation and congestion of the blood-vessels. But when the disease has been of long standing, a section shows the glandular structure itself to have participated. The secreting tubes are closely united together, and to the subjacent coats; their basement-membrane is greatly thickened; and they are distended with cells and granular matters, which often project like little lumps from their orifices. At a later stage the tubes become atrophied, and only a few fatty cells remain to point out their former site; or their free ends are obstructed, whilst their lower ends are dilated into a flask-like form. The grey pigment may be deposited either between the tubes or in the cells themselves. The solitary glands are generally enlarged, and tend to atrophy the tubes by their pressure. Patches of thickened layers of epithelium may remain attached to the surface, showing that a condition may exist in the stomach analogous to squamous diseases of the skin.

SYMPTOMS.—There is a great difference amongst authors as to the symptoms produced by chronic catarrhal gastritis. This, no doubt, in part, arises from the fact that simple and uncomplicated cases are so rarely fatal, and that we have, therefore, but few opportunities of verifying the diagnosis by *post-mortem* examination. But it also depends on the symptoms of other co-existing affections being so often described along with those arising from the deranged stomach. There is seldom much complaint of pain, excepting it be a sense of fulness and oppression at the epigastric region after food. When there is acidity, the patient often experiences a severe burning from the stomach to the throat. In such cases temporary relief may be afforded by food or stimulants, on account of the introduction of fresh aliment exciting the stomach to increased action, so that the decomposing remains of the previous meal are either neutralised or hurried through the pylorus. There is generally a certain amount of tenderness at the pit of the stomach, which is most evident in the cases in which congestion of the liver is also present.

The appetite is variable, being usually lessened; but in other cases a craving for food is experienced. Nausea is a common symptom; but vomiting, in the ordinary run of cases, is not so frequent as might be expected. When the affection has been induced by drunkenness, a rejection of mucus in the early morning takes place, and in gouty subjects this forms a most distressing symptom. Acid eructations, and a sour taste in the mouth, are commonly complained of. These probably arise from particles of undigested food remaining entangled in the mucus, setting up acetous or lactic acid fermentation in the saccharine and starchy articles of diet. The writers prevailed upon a number of patients who were suffering from this symptom to excite vomiting in the early morning by drinking warm water. In every case a quantity of thick, ropy mucus was rejected, and intermixed with it were portions of partially digested food. In some the amount of fluid rejected was so large that the conclusion could not be resisted that the muscular coat had been enfeebled by the inflammation, and had been thus unable to completely expel its contents. Thirst is often present, and, as a general rule, is most complained of towards evening. The bowels are usually confined, but where the catarrhal condition has extended to the intestines, frequent attacks of diarrhœa take place. The urine is high-coloured, depositing lithates; but as the inflammatory condition subsides, it may become of low specific gravity, alkaline or slightly acid, and may deposit pale-coloured lithates or phosphates. Where the oral cavity is, as is usually the case, also inflamed, the throat presents a red, congested appearance. The tongue is large, indented with the teeth, and, if the liver is simultaneously congested, is coated with a thickened epithelium of a brown or yellow hue. If the catarrh have extended to the salivary glands, the surface of the tongue becomes dry, or is covered with a white, creamy mucus. If the duodenum be affected, the patient is liable to jaundice from obstruction of the biliary passages. Generally the results of imperfect lacteal absorption are shown in loss of flesh, dryness and harshness of the skin, and imperfect nutrition of the hair and nails. The pulse is ordinarily slow, full, and regular. A short cough is often complained of. The temperature is seldom increased, excepting towards evening, and the patient often complains of coldness in the extremities. The nervous system almost always suffers. There is great wakefulness, or the patient wakes after a few hours of broken and disturbed slumber. Attacks of headache are frequent, the pain affecting chiefly the forehead and eyeballs.

It is necessary to notice two important varieties of the complaint, both on account of their practical importance, and also from the little attention they have received from authors. In one class of cases the prominent symptom consists in the rejection of an enormous quantity of mucus. This may occur almost constantly, vast amounts of glairy or of blood-stained mucus being rejected. In other instances the vomiting occurs only every few days, mostly after breakfast; and, from the quantity expelled, it would almost appear as if a gradual accumulation took place before each attack, until the stomach was excited to get rid of it. There is often no nausea preceding the vomiting, and but few gastric symptoms between the attacks. This form of gastric catarrh is most apt to occur in females, but it may also affect the other sex. The second variety appears to be an eczema of the stomach; at any rate, the catarrh of the mucous membrane replaces a similar catarrhal condition of the skin, and is often relieved as soon as the latter reappears. In many cases the condition may be attributable to a gouty diathesis, of which both the skin-affection and that of the stomach are the expressions. Still, this alternation between the disorder of the skin and stomach is not infrequently witnessed in practice.

Diagnosis.—The only disease likely to lead to mistakes in diagnosis is atonic dyspepsia; but we may meet with very rare cases of chronic catarrhal gastritis that are difficult to distinguish from ulceration and cancer of the stomach. Where, as occasionally happens, a certain amount of hæmatemesis presents itself, the diagnosis between this disease and ulceration requires care. But in catarrh there is usually some co-existing disease of the heart or liver, or some disorder of menstruation; there is an absence of pain, or, if pain be present, it is relieved, not increased, by food, as in the case of ulcer. Again, the vomiting is less excited by food; the epigastric tenderness is slight and diffused, not confined to one particular spot, as in ulcer. Cases are sometimes mistaken for cancer. The pain, however, in gastric catarrh is slighter; the tenderness comparatively trifling; and the hæmatemesis is never excessive or long-continued, as in cancer. On the other hand, in the latter disorder there is a more rapid loss of flesh and strength, and more pallor of the lips and complexion. The discovery of a tumour in the epigastric region, or in some other organ, would remove all doubts as to the real nature of the malady.

Treatment.—The first point as regards treatment is to discover, if possible, the cause of the disease. It is useless to attempt to relieve an inflammation of the stomach, so long as the veins of the organ remain in a state of congestion produced by a disease of the heart or lungs. Cases that had been ineffectually treated for months with purgatives and tonics have yielded at once to rest and digitalis, prescribed on account of the discovery of a dilated heart. In other instances, chronic Bright's disease, by preventing the due elimination of the effete matters, gives rise to the gastritis; and, under such circumstances, treatment directed to the relief of the original affection yields more satisfactory results than that which would be ordinarily prescribed for inflammatory dyspepsia. Constipation will be often found to have preceded the gastric symptoms, which have been produced by the food being too long retained in the stomach, from the diminished muscular activity of the whole canal. Here a regular action of the bowels is the main indication for the relief of the gastric catarrh. There is often, as before mentioned, a craving for food every two or three hours, set up by the presence of mucus in the stomach. Numbers of cases prove rebellious to treatment, because the patient persists in seeking temporary relief by frequently cramming the stomach with food, or because he keeps the mucous membrane in a state of excitement by stimulants, taken under the idea that debility is the cause of his sufferings. In the majority of very obstinate cases, one or other of these habits requires to be overcome, before other treatment can be made available. The mere removal of the cause producing the disease is often sufficient to ensure its cure, but in other instances we are forced to employ other means. The chief indication in the ordinary run of cases is to take off any increased pressure upon the venous circulation. In any glandular structure we can only effect this object by lessening the amount of blood flowing to it, or by increasing the rapidity of the circulation through the organ by stimulating its secretion. The first of these objects in the case of the gastro-intestinal tract is accomplished by purgatives, which drain away a large quantity of the liquid portions of the blood which has to pass through the vena portæ. In young and vigorous subjects, therefore, salines, such as the sulphate of magnesium, tartarated soda, or the mineral waters of Pullna or Friedrichshall, may be employed. These may be assisted by small doses of mercurials, given every second or third night. The salines should not be too long continued alone, as they are apt to enfeeble the muscular powers of the canal. After a short period, it is necessary to combine them with a tonic, such as quinine, gentian, or calumba, or with sulphate or phosphate of iron. In more feeble subjects, or in those who have previously suffered from atonic dyspepsia, it is better to relieve the congestion by stimulating the biliary secretion. For this purpose, taraxacum or chamomile may be employed, assisted by a pill each night, containing podophyllin or blue-pill. In another set of cases, where the patient is not robust, both objects may be attempted at once—by the administration of soda and rhubarb in the day, assisted by an occasional dose of blue-pill at night, or by a course of the Carlsbad water every morning.

It has been before remarked how readily fermentation is set up, whenever the secretion of the gastric juice is lessened or arrested. This circumstance must be borne in mind in the treatment of this as well as of other gastric disorders. As soon as the more urgent symptoms of chronic gastritis are subdued in any case, tonics, such as iron, calumba, or quinine, along with acids, may be used to obviate the enfeebled state of digestion that always results from the long continuance of the inflammation.

The treatment of cases where large quantities of mucus are vomited must be conducted on a different principle. Here the venous system is in a state of passive congestion, and no active inflammation of the mucous membrane is in progress. We must use astringents, the best of which are bismuth, nitrate or oxide of silver, oxalate of cerium, kino, tannin, and opium. Purging makes the patient worse. In order to obviate the ill-effects of the astringents, it is necessary to give each night a pill of podophyllin and creasote, or of nux vomica and aloes, or some other similar preparation. In obstinate cases of chronic gastritis, and especially where there is frequent vomiting of mucus, the stomach should be washed out every two or three days with Vichy water or a weak solution of bicarbonate of sodium (*see* LAVAGE). The patient should be cautioned not to pass the tube too frequently. To avoid the removal of the partly digested food, it is better to have the operation performed in the early morning. Many patients find great comfort from the use of a compress, which may be worn either during the day or, in obstinate cases, both night and day. In all cases where a compress is not employed a warm abdominal bandage should be used.

Eczema of the stomach is most difficult to treat satisfactorily, probably because it depends on the general state of health. It is best relieved by moderate doses of solution of potash, taken a little before the time when the scalding pain is expected, assisted by a pill, every night, of podophyllin and creasote. In other instances, a combination of bismuth, soda, and carbolic acid is successful in removing the pain after food. As soon as the urgent symptoms have been overcome, benefit may be expected either from the official compound iron mixture, or from quinine combined with ammonia. Flannels dipped in a solution of common washing soda, and covered with indiarubber, may be applied over the epigastrium with benefit; or a liniment of croton oil may be employed. The latter must be used with great caution, as, from the unusual irritability of the skin, the eruption is apt to be very severe.

Theoretically, it might be expected that a farinaceous diet would not be suitable in these cases, inasmuch as it is apt to set up fermentation. It is better to confine the patient to sparing meals of mutton, chicken, game, or fish, along with bread. Vegetables and fruit should be at first avoided, but may be freely used as soon as the more urgent symptoms have subsided. The breakfast is the most difficult meal to manage, for tea and coffee are apt to disagree and increase the mischief. Dandelion coffee is often very useful in such cases. It is made by boiling the roasted and dried root of the taraxacum with a quarter of its weight of the best coffee. Where this cannot be readily obtained, the taraxacum juice of the Pharmacopœia may be taken, along with weak coffee. If milk does not disagree, it may be used, mixed either with lime-water, Seltzer, or Vichy water. Alcohol should be avoided; but if from long habit or other circumstances its use is necessary, a small quantity of weak spirit and water may be substituted for wine.

14. **Stomach, Lardaceous Disease of.**—This affection is an exceedingly common accompaniment of lardaceous disease in other organs, especially when the liver and intestinal tract are affected. It may occur as the result of prolonged suppuration from bone-disease, but is most usually met with in cases of chronic pulmonary phthisis (87 per cent. of all cases of chronic phthisis) (Fenwick). As a primary affection it is excessively rare, only four cases being recorded (Marfan). The disease usually commences in the pyloric region, the inner coats of the interglandular capillaries being the first to show signs of degeneration. Next in frequency come the capillaries which ramify on the surface of the mucous membrane, and the longer vessels situated in the neighbourhood of the blind extremities of the gastric tubes and in the submucosa. In an advanced case, almost the whole of the tissue of the wall of the stomach is found affected. Large areas of muscular tissue are completely lardaceous, as well as their nutrient vessels. The connective-tissue elements give a brilliant reaction with the aniline dye, and even the membrana propria and the peptic cells may suffer. The vessels which enter the solitary lymphoid follicles are early affected by the disease, and a marked atrophy of the follicle is usually observed in advanced cases; but the lymphoid elements themselves possess a considerable degree of resistance towards the lardaceous change.

Three results of this degeneration are particularly to be noted. In the first place, as in the case of the kidney, the disease of the vessels tends to deprive the secreting cells of their proper degree of nutrition, and hence we find that lardaceous disease is always accompanied by well-marked signs of tubular gastritis. Secondly, hæmorrhage is apt to occur from rupture of the weakened wall of the affected vessels; and the writers have convinced themselves by repeated observations that the superficial ulcerations so common in the pyloric region of advanced cases of pulmonary phthisis originate in this manner. Thirdly, the lardaceous degeneration of the muscular tissue is a potent factor in the causation of the dilatation of the stomach which is so commonly found in advanced cases of phthisis.

The *symptoms* of lardaceous disease present no striking peculiarity. It must be mentioned, however, that marked anæmia is usually present, and that Edinger has shown that free hydrochloric acid is usually absent from the gastric secretion in these cases.

15. **Stomach, Malposition of.** — The stomach may be displaced congenitally; or as a result of accident or disease.

In congenital displacement the stomach may be situated on the right side of the body, the fundus pointing to the right hypochondrium, the pylorus to the left. But, as in such cases it will be also found that there is a similar malposition of the heart, liver, and spleen, no mistake in diagnosis is likely to occur. As a congenital condition, the stomach may occupy the left pleura, through a partial arrest of development of the diaphragm. It may be also situated in the left pleura, owing to a rupture of the diaphragm. It is said that such a state has given rise to a mistake in diagnosis between it and pneumothorax of the left side. In both there is a clear sound on percussion, and a gurgling produced by motion of the body. Besides this, the pressure of the distended stomach has been seen to displace the heart, and produce dyspnœa. Bamberger has pointed out that in protrusion of the stomach into the left pleura the respiratory sounds can be heard in the upper part of the left lung; the clear note on percussion becomes duller after food; and any metallic sounds that may present themselves are unconnected with the breathing of the patient. The dyspnœa of congenital displacement is only occasional, not persistent, and it will be found to have existed for years, instead of occurring suddenly, as in pneumothorax. When the hernia has resulted from an accident, it is usually accompanied by vomiting of fluid containing sarcinæ, and by other signs indicating that the stomach does not get freely emptied of its contents.

The organ may be displaced downwards by the weight of a tumour situated in its coats. This is more especially the case with the pylorus, which is generally the seat of such a morbid change. Under these circumstances, the pylorus may be so depressed as to occupy the right iliac region, or it may have fallen still lower, and be united by adhesions to some of the pelvic viscera. In some cases the stomach is found in the contents of large umbilical and scrotal herniæ. When a stomach is much dilated, in case no adhesions have been formed between it and some of the neighbouring organs, it is displaced downwards by the weight of its contents.

16. Stomach, Morbid Growths in.—The stomach is liable to all the forms of morbid growth that are met with in the other structures of the body. Excepting the breast and uterus, no part is so frequently the seat of malignant disease. All the varieties of cancer attack this organ, and not infrequently they are combined. Thus we meet with scirrhus and encephaloid, or scirrhus and colloid, in the same tumour.

Scirrhus is by far the most common, constituting, according to the researches of Dr. Brinton, three-fourths of the whole number. Its most usual seat is the pylorus or the lesser curvature, and here it forms a tumour which rarely invades the duodenum, but tends to surround the organ. When a section is made at an early period of the disease, the distinction between the different coats is readily seen. The peritoneum and the tissue directly beneath it are thickened; the muscular structure is of a grey colour, and much increased in bulk, the bundles of fibres being divided from each other by firm septa of connective tissue. The mucous membrane covering the tumour may appear to the naked eye to be healthy. Sooner or later ulceration takes place, and a deep excavation results, with thickened elevated edges, and with a base not infrequently covered with fungoid projections. Microscopically the tumour presents the ordinary appearances of scirrhus. The muscular tissue is usually in a state of degeneration near the cancerous structure, even when it has not been invaded by the disease. The mucous membrane has been more or less diseased in all the cases the writers have examined, even at a distance from the tumour. The tubes were generally united to each other; and were, in many places, in a state of atrophy or of fatty degeneration.

Encephaloid cancer has affected the stomach in about one-tenth of the cases recorded, according to the inquiries of Dr. Brinton. It forms soft, quickly growing nodules, which project beneath the peritoneum, or elevate the mucous membrane. It seems generally to commence, as scirrhus does, in the submucous tissue. When ulceration occurs, numerous fungoid masses, which are often very vascular, project upwards. The muscular coat is more completely destroyed in the neighbourhood of the tumour than in scirrhus, and the mucous membrane is generally diseased in all parts of the organ. The tubes are not, however, so much atrophied as in the harder form of cancer, but are usually distended with cells, and the subtubular and intertubular spaces are occupied by cells of various sizes.

Colloid cancer is generally associated with scirrhus. The structure feels softer than when scirrhus is present alone, and consists in part of a gelatinous material contained in round or oval spaces bounded by connective tissue. Dr. Brinton calculates that only 9 per cent. of all the cases of cancer of the stomach are composed of colloid uncombined with scirrhus.

Epithelioma may occur in two forms. The most frequent variety presents itself as soft white masses in the submucosa, which rapidly destroy the subjacent mucous membrane and tend to ulcerate. Microscopically the growth is found to consist of tubular alveoli which are lined by columnar cells, while the lumen is not infrequently occupied by nests of cells of irregular formation. The stroma is deficient, and often represented by an infiltration of small cells. The true squamous epithelioma is much rarer than the cylindrical type, and is exclusively met with at the cardiac orifice, where it obviously originates in the lower end of the œsophagus. Ulceration is tardy and never very extensive.

Lipoma, *sarcoma*, and *adenoma* are also occasionally met with in the stomach.

Tubercle is very rare, and only found where there has been general tuberculosis.

Five cases of non-malignant tumour of the stomach are noted in the *post-mortem* records of the London Hospital. In one case a tumour—the nature of which is not mentioned—was found growing from the smaller curvature; one consisted in a large cyst attached near the pylorus; in a third there was a fatty tumour in a woman who seems to have died from heart-disease; a boy aged fourteen who had been killed by an accident presented a tumour attached to the peritoneal coat; and another who died from a perforating ulcer had a fibroid tumour situated near the ulcer. In all probability many have been omitted, as cases of adenoma and other forms of growth have fallen under the notice of the writers.

The *symptoms* and other clinical relations of morbid growths in the stomach are described under 4. Cancer.

17. Stomach, Neuroses of.—Under this head are generally included cases in which the symptoms point to a functional disorder of the stomach, unaccompanied by any change in the various structures of which the organ is composed. Looking at the subject from a physiological point of view, it is evident that the sensibility, the special sense, the motility, and the vaso-motor system must all be liable to deviation from their normal state, and should be therefore considered, each of them, separately. But it can scarcely be supposed that, in an organ the functions of which are so important and so complicated, any one alteration from the healthy state will generally present itself alone; and on this account it will be necessary to bear in mind that one functional change may be combined with others. Thus a great diminution of the special sense is commonly associated with an alteration in the ordinary sensation of the stomach, or with a diminution in its power of secretion, whilst an increase of its sensibility and irritability is often accompanied by an augmented activity of the glandular apparatus.

(1) **Neuroses of Ordinary Sensibility.**—*Morbid Sensibility of the Stomach.* Modifications of the sensibility of the digestive canal, unattended by pain, are by no means uncommon, and usually occur in persons suffering from nervous exhaustion. Under the name of 'morbid sensibility,' this disorder at one time attracted considerable attention, and almost every form of dyspepsia was referred to it. In a case of this kind the patient can often trace the passage of the food along the mucous membrane, especially when it has been taken warm or is of a stimulating character. In some there is a sensation as if the digestive tube were in a state of constant motion, and this often gives rise to a suspicion that the patient is suffering from worms. When, as is not infrequently the case, the action of the stomach is so impaired that portions of the food are passed in an undigested state, these insoluble materials are often looked upon as indubitable evidence of the existence of parasites. Others describe a sensation that shows still more the excited condition of the nervous system. It is as if 'a wave' passed over and obscured the mental faculties for a second, this feeling being instantaneously followed by a movement of flatus in the stomach or intestines. The tongue is usually clean; the appetite good, sometimes craving; the urine clear, depositing phosphates or the oxalate of calcium. The bowels are almost always confined; and in females especially, but sometimes also in the other sex, the abdominal aorta may be felt to pulsate with unusual force. These evidences of disorder in the digestive canal are always associated with others, indicating a feeble condition of the nervous system. Attacks of giddiness and mental depression are seldom absent; there is usually loss of strength, sometimes general emaciation; and the severity of these symptoms seems to be increased by any exacerbation of the disorder of the digestive organs.

Cases of this description, attended by great irritability of temper or despondency, not infrequently occur in persons of middle age who are hereditarily predisposed to gout or rheumatism; and the gastric symptoms may be suddenly replaced by muscular rheumatism or by an attack of sciatica.

The most marked examples of this complaint, however, occur in women about the period of the cessation of the menses, and are attended with a sense of fulness or distension after the smallest quantity of food, or these feelings may persist even when all food has been refused. The appetite is bad, or there may be a loathing of food. The bowels are usually constipated, but act readily with aperients. There is often a sensation of heat or scalding in the mouth and tongue, or it is described as if the tongue had been 'peppered.' In some instances the same feeling is complained of as extending down the œsophagus to the stomach; and more rarely there is a loss of sensation in the gullet, so that the food cannot be felt as it passes downwards. In other instances, the patient feels faint after every action of the bowels, and has to lie for hours in the recumbent position after their evacuation. There is almost always rapid loss of flesh and strength; sleeplessness, irritability of temper, or great despondency are usual accompaniments of this condition; and in many cases neuralgia of the head, back, or sciatic nerve adds to the sufferings of the patient.

TREATMENT.—The treatment of such cases is very difficult, as the patient is usually too impatient to follow out any regular course that may be recommended. It is advisable to commence with sedatives, such as the bromide of potassium, and to follow these with tonics. Travelling is almost always beneficial, but all undue exertion should be avoided.

The diet requires careful regulation, and should be varied according to the condition of the digestive organs. Practically, the best information respecting the suitability of the food may be obtained by watching the sensations of the patient. Whatever meal has been followed by an augmented sensibility of the digestive canal, or by an increase in the mental distress, must have been unsuitable either in quantity or quality, and observation will soon show in what way the diet may be best improved.

As a general rule, the food should be sparing in amount, and vegetables, soups, wines, and other articles difficult of digestion or apt to produce acidity, must be avoided. Bread, lean meat, and farinaceous food should form the chief articles of diet; and all stimulants should be prohibited, unless there is some special indication for their employment.

Hyperæsthesia of the Stomach.—The commonest form of this disorder shows itself as the result of ulceration of the stomach occurring in young persons. It is often exceedingly rebellious to treatment, and is probably analogous to the neuralgic affections of the ankle and knee that so frequently follow injuries of these parts in hysterical females.

The usual history of such a case is that a patient has been suffering from the symptoms of gastric ulcer, and has been kept for some time with marked benefit upon a liquid diet, when without apparent reason, although the vomiting may have ceased, the pain returns as severe as before, or even increases in violence. Its character also not infrequently changes. Sometimes it is as severe after liquids as after solids; in other instances it ceases for many days and reappears without any evident cause; or it comes on directly after the food has been taken, but does not last during the whole of the digestive process; or it may attack the patient more severely at night, when the stomach is empty, than during the period of its greatest activity.

The localised tenderness characteristic of gastric ulcer is usually replaced by a general sensitiveness of the epigastric region, or the whole of the abdomen appears unduly sensitive, deep pressure provoking less complaint than a slight touch. The pain is usually less affected by exercise or standing than during the period of ulceration, but it is not infrequently increased at, or just before, the catamenial periods. Under these circumstances it will be often observed that the patient is gaining flesh, that the appetite is good, sometimes craving, and that flatulence is a prominent symptom, even when pain is not present. In some cases there is a well-marked interval between the cessation of the symptoms of ulceration and the appearance of those of the hyperæsthesia. In other patients the pain very gradually alters in its character, and it is impossible to say when the hyperæsthesia has replaced the suffering resulting from the ulceration. In fact, in many cases it is only by watching the effects produced by a tonic treatment that we are able to convince ourselves of the neuralgic nature of the complaint.

Abdominal Neuralgia.—Neuralgia rarely occurs in the gastro-intestinal tract, excepting as the result of some organic change in it or in the neighbouring organs. Since the abdominal nerves are not exposed, as those of the limbs, to sudden changes of temperature, nor are surrounded in their course by unyielding bony structures, as the nerves of the head and face, they are less liable to this affection than other parts of the body. Again, as malaria, syphilis, and gout, which are the chief predisposing causes of neuralgia, ordinarily affect such of the abdominal organs as are but little endowed with sensitive nerves, it is seldom produced by constitutional ailments. We should, therefore, be most cautious in our diagnosis of idiopathic neuralgia as affecting the digestive tract. Everyone must have seen how often the subsequent development of an aneurysm, a deep abscess, or disease of the bones of the spine, has explained the cause of pains of the abdomen, which had been unhesitatingly referred to a mere nervous affection in the early stage of the malady.

The practitioner will, however, encounter cases in which there are severe attacks of pain, evidently of a neuralgic character, occurring in various parts of the abdomen. They may come on at any time of the day, are not increased by food, are usually aggravated by exertion, either bodily or mental, and are relieved by the recumbent position. In some they are accompanied by severe pains of the head or face, both pains coming on and subsiding at the same time. Symptoms of dyspepsia are occasionally present; more frequently they are absent. The best-marked cases occur in those who have been long in the tropics, or who live in malarial districts; but not infrequently they present themselves in persons liable to gout who have been suffering from great mental anxiety or distress. Arsenic and quinine are the most useful remedies, and where there is much nervous exhaustion the valerianate of zinc or phosphorus may be added with benefit.

(2) **Neuroses of the Special Sensibility of the Stomach.**—The appetite, which is the special sense of the stomach, and by which the supply of food required for the system is regulated, is frequently disordered. It may be increased, perverted, or diminished. Usually these changes result from some abnormal condition of the whole body, or of some important organ, but occasionally they arise from a nervous affection of the digestion alone.

A great *increase in the desire for food* not infrequently accompanies chronic gastric catarrh. It occurs two or three hours after a meal; is attended with a sensation of giddiness, faintness, or palpitation; and is relieved for a time by food or stimulants. It is, in all probability, produced by the irritation of partially digested food, a fresh supply of nutriment calling forth a new secretion of the gastric juice, and thus affording temporary relief.

There is another form of increased appetite which does not arise from an inflammatory state of the stomach, but occurs chiefly in young females who are of a nervous or hysterical temperament. The craving takes place usually at night, even after a late dinner, and the distress arising from it is often so severe that large quantities of food are consumed before the appetite can be appeased. In all probability it arises from an excessive irritability of the stomach, which causes the food to be hurried into and along the intestinal canal before digestion and absorption can be completed. In many instances it is associated with diarrhœa, and the stools consist largely of undigested materials.

A complete *failure of appetite* attended with great wasting of the body has been described as 'anorexia nervosa.'

It seems to be confined to young persons; in most instances it first makes its appearance between fifteen and twenty. It occurs chiefly in the female sex, but boys may be also the subjects of it. It is much more common in the wealthier classes of society than amongst those who have to procure their bread by daily labour.

The earliest indication of a failure in health is a distaste for food. At first butchers' meat is alone disliked, and the patient will partake freely of fish, vegetables, or fruit. The latter is more generally chosen, and some will eat oranges or apples when all other kinds of nourishment are refused. There is no vomiting and no complaint of pain, but in many cases a sensation of fulness is experienced. The bowels are almost always constipated, and the evacuations hard, dry, and knotty. The extremities are cold, especially at night, the action of the heart is feeble, and the pulse is small, slow, and regular.

In almost every instance, even at an early period, the temper is irritable, the patient becomes obstinate and self-willed, the sleep is very imperfect, and dreams and nightmare form constant subjects of complaint. In one case the patient was liable to slight hallucinations. Still more remarkable is the restlessness. One of the writers has known a patient in this condition so unable to remain at home that she would undertake railway journeys without any apparent motive, and although she knew they would be followed by attacks of severe exhaustion that would confine her to her bed for many days. Others will take long and purposeless walks, and it is a matter of surprise how persons eating so little can undergo so much fatigue. Emaciation soon shows itself, the patient steadily loses weight, the cheeks become thin, and she presents the appearance of advanced phthisis. The ankles in almost every case begin to swell at an early period, and this is often the first symptom that alarms the friends and convinces them of the serious nature of the malady. In other instances violent attacks of palpitation have occurred, attended with great dyspnœa and fear of instant death. The pulse under these circumstances is often exceedingly rapid (130 or 140 in the minute), and yet in two or three days it may gradually fall, the exhaustion may pass off, and the patient resume her former state. The catamenia are always irregular, often suppressed, and in one case did not return for five years, although the other symptoms had disappeared.

In severe cases, where the complaint is allowed to proceed unchecked by treatment, the situation of the patient becomes most pitiable. The dislike to food increases, until it is necessary to force it upon her; and as there is little or no thirst, even liquids are refused. The restlessness, which is so marked a feature in the earlier stage, now disappears, and the patient becomes less and less capable of exertion, until at last she is entirely confined to the recumbent position. The wasted limbs require to be kept apart, lest ulcerations should be produced by their contact, and the back and nates demand constant attention to prevent the formation of bed-sores. The patient often lies in a condition of semi-consciousness, from which she can be roused, but into which she relapses as soon as she is left to herself. The pulse is small and feeble, and often very rapid. The skin is dry and harsh; the bowels are obstinately confined; and the urine scanty, and of low specific gravity.

Even from this condition the patient may be gradually restored to health by proper treatment; but, as may be readily imagined, many are allowed to sink under the idea that they are suffering from tubercular disease of the lungs or brain.

TREATMENT.—As the disease consists only in the loss of appetite, whilst the power of digestion remains intact, it is evident that careful and regular feeding of the patient must be the first principle in the treatment. In the early stage it is advisable to try to overcome by argument her dislike to food, as the physician can rarely at this period rely upon the active co-operation of her friends. So long as she can walk about, she can point out that her activity is increased rather than diminished by abstinence, and the ignorance of relatives generally leads them to blame any determined attempt at forcible feeding. Every means, therefore, should be employed to tempt the appetite, and observation will usually show that certain articles of diet are less distasteful than others. In many cases fowl, game, or even shell-fish, will be taken when beef and mutton are obstinately rejected; in other cases vegetables and fruit are selected. Milk in various forms should be tried, either cold or thickened with vermicelli or macaroni; jellies and farinaceous puddings are sometimes acceptable, and, although inferior to other articles of diet for the purpose of nutrition, they supply matter for oxidation, and thus save the rapid waste of the tissues. Not infrequently the patient may be induced to choose her own diet, and it is then better to acquiesce in her choice than incur the risk of increasing her obstinacy by insisting on more wholesome food. In the later stages, when she has become so feeble that she is unable to go about, forcible feeding should be adopted. The patient ought to be treated as a person of unsound mind, and moderate quantities of milk, soup, beef-tea, eggs, or any other kind of nutritious food, must be frequently administered. Friends are never to be relied upon, but the case should be entrusted to a properly trained nurse, who must be held responsible for carrying out the treatment.

Tonics of some kind are always useful, but the patient often cannot be prevailed upon to take them. In the early stage, if anæmia is present, we may use some preparation of iron, such as an effervescing citrate mixture, the phosphate, or the saccharated carbonate, or it may be combined with quinine and strychnine, or with calumba or quassia, according to the circumstances of the case. Where there is no anæmia, or when iron disagrees, zinc may be prescribed, especially the valerianate or the sulphate. In cases in which the feeling of distension is very marked, the writers have seen more benefit from the use of pepsin and hydrochloric acid after meals than from the mineral tonics.

(3) **Neuroses of Motility.**—These are the most common and the best known of the neuroses of the stomach, but they often present considerable difficulties both in their diagnosis and treatment. The most usual deviations from the healthy condition are (*a*) *spasm*, (*b*) *eructation*, and (*c*) *vomiting*.

(*a*) *Spasm of the Stomach.*—Spasm of the stomach is a common accompaniment of all forms of dyspepsia occurring in persons of a nervous temperament. It probably arises from a closure of the cardiac orifice, preventing an escape of gas from the organ when it is distended with the products of fermentation. An attack is usually preceded by a sense of weight upon the chest, or a feeling of constriction, arising from imperfect digestion of the food. It generally comes on a few hours after a meal, especially during the night, when an escape of the gaseous contents of the stomach has been prevented by the recumbent position of the patient. It may be accompanied by ineffectual efforts at eructation or vomiting, but even when an escape of some of the contents of the organ takes place, relief is not necessarily obtained.

The severity of the attack depends much upon its duration. Where it passes away quickly, pain may be the only symptom; but where the spasm is long-continued and severe, other organs of the body are liable to be implicated. Thus, the action of the heart may become feeble and irregular, the pulse weak and fluttering, the face covered with perspiration, the extremities cold, and the respiration laboured and difficult. The patient sits upright, or rolls from side to side, in vain attempts to gain relief from the agonising pain with which he is affected. The epigastrium feels hard and distended, and is very tympanitic on percussion. The writers have seen the suffering so intense, and the collapse so sudden and severe, that they have doubted whether the patient were not suffering from perforation into the peritoneum. In some instances the attack disappears as suddenly as it came on, but more generally it subsides gradually.

Treatment.—The prevention of spasm of the stomach requires the removal of any morbid condition that may be present, and that is capable of giving rise to imperfect digestion of the food. It must be borne in mind that the patient is almost always of a nervous temperament; and that if aperients are requisite, they should be combined with a stimulant or antispasmodic. The diet must be carefully regulated; and effervescing liquids, as well as articles of food that are liable to ferment, such as uncooked fruit and vegetables, wines and malt liquors, must be prohibited.

During an attack, if it be of moderate severity, an alkali, combined with a stimulant and sedative, is usually sufficient to afford relief. For instance, a dose of bicarbonate of sodium or of magnesium, with chloroform or ether and morphine, is generally preferred. In the more severe cases the subcutaneous injection of morphine is requisite; and if the heart is much depressed, ammonia or brandy may be given, either by the mouth or in an enema.

The application of heat and warmth to the epigastrium is always of service, and flannels wrung out of hot water and sprinkled over with laudanum or turpentine, and a hot-water bottle, are favourite remedies. In some cases a mustard plaster, or, where the pain resists other treatment, a hot bath, is efficacious in affording relief.

(*b*) *Eructation.*—Eructation is a common symptom of dyspepsia, and is especially apt to occur to an excessive degree in women about the time of the cessation of menstruation. It is usually associated with flatulence, constipation, and other signs of feeble digestion, and it often proves very rebellious to treatment. But it may also occur in the young, as a purely nervous symptom, and is then apt to be very obstinate. Eructations occasionally result from malaria, and one of the writers has seen them replaced by almost constant hiccough, which was relieved by a course of arsenic.

(*c*) *Nervous Vomiting.*—It is unnecessary to mention that vomiting is one of the most common symptoms of various affections of the brain. It also frequently presents itself in locomotor ataxia, and may be one of the earliest symptoms of that disorder. As a rule, the attacks are accompanied by pains in the epigastrium, chest, or abdomen, and are often extremely severe; but the writers have seen persistent vomiting unattended by pain precede various affections of the spinal cord. In most cases the attacks of pain and vomiting subside after a few days, but recur from time to time. In some instances they seem to occur periodically. The pains are sometimes referred to the abdomen, and the functions of the intestinal canal are mainly affected. The patient may suffer from severe colic, attended with great distension of the abdomen, and constipation. In others diarrhœa is the most prominent symptom, which may not be accompanied by pains; and, unless great care be taken, mistakes in diagnosis are certain to occur. The writers have seen the earliest symptom consist in severe neuralgic pains about the anus, along with the passage of small and frequent stools. This was followed by frequent attacks of uncontrollable vomiting, and after some months the usual symptoms of tabes dorsalis presented themselves.

Vomiting is also a prominent symptom in 'Addison's disease,' probably from the changes that occur in the ganglia and nerves in that disorder; but the diagnosis must be determined by the other symptoms, and by the characteristic appearance of the patient.

A form of nervous vomiting known as *hysterical vomiting* is not infrequent. It occurs shortly after a meal; so quickly, indeed, in many cases, that the patient is forced to leave the table. It is not attended with nausea, and does not take place when the stomach is empty. What is rejected is usually tasteless; but when the vomiting occurs some time after eating it is sour, from the food being more digested. In many cases, although this is by no means necessary, this form of vomiting is accompanied by a sensation of weight or uneasiness after eating, flatulence, and other signs of dyspepsia. The bowels are almost always greatly constipated.

Although vomiting may occur at every meal, only a portion of what has been taken is rejected, for there is no great loss of flesh or strength. Not infrequently the patient looks unusually healthy and robust, very different from the emaciated and cachectic subjects of gastric ulcer. There are usually other manifestations of hysteria, such as the sensation of a ball in the throat, difficulty of swallowing, or palpitation. The catamenia are in most instances disordered, often absent; but at times they are more frequent than usual, and excessive in quantity.

There is another form of nervous vomiting which has but little attracted the notice of practitioners. It occurs in persons who have been long exposed to malaria, and often makes its appearance when no other evidences of malarial poisoning are present. It is probably from this reason that its true nature is so commonly overlooked.

The vomiting is at first only in the early morning or after breakfast, and does not trouble the patient in the subsequent part of the day. By degrees it becomes more constant, occurring directly after every meal, and especially after solid food, and even awaking him during the night; sometimes the food is described as sticking in the lower part of the chest, and the patient is uneasy until it is rejected. The appetite is bad, extreme debility is always present, there is rapid loss of flesh, the skin is sallow, the lips bloodless, the expression anxious; and the appearance of the patient is so cachectic, that the practitioner expects to find a carcinomatous tumour in the epigastrium. The writers have often diagnosed cancer of the stomach in such cases, and have seen a similar mistake made by others; and this is the more excusable, as the vomiting is often most intractable, and the patient seems rapidly to lose ground in spite of all the ordinary treatment adopted to relieve him. When the nature of the malady is clearly appreciated, and quinine or arsenic employed, the vomiting usually subsides, and improvement in the general health is often rapid and striking.

(4) **Neuroses of the Vaso-motor System.**—The secretion of the stomach, which is under the control of the vaso-motor system, is liable to be increased or altered in various neurotic affections; in some of the cases of gastric neuralgia, for example, the pain is accompanied by excessive acidity. Whether the augmented secretion arises from the nervous affection, or whether both are the result of a general cause, such as gout, is a question we are at present incapable of satisfactorily answering. In the neuroses of motility an increase in the quantity of acid secreted is often a prominent symptom. But not only alterations in the secretion, but even catarrhal inflammation of the stomach may arise from a morbid action situated in other and distant organs; thus, we not infrequently see vomiting of enormous quantities of mucus during menstruation, no signs of disturbed digestion being present in the intervals. In some rare cases blood is vomited during menstruation, and the writers have seen enormous quantities of blood-stained mucus evacuated, the digestion being unaffected at other times. In all probability, some of the cases of diarrhœa that occur in hysterical subjects result from vaso-motor disturbance.

18. **Stomach, Perforation of.**—With the exception of a few rare cases where the coats of the stomach have been penetrated by mechanical injuries, or by the extension of disease from some of the neighbouring organs, perforation of this viscus is the result of ulceration. In the majority of the cases of ulceration, the peritoneal covering of the stomach inflames as the disease approaches it, and the organ becomes attached to some of the adjoining parts. In this way a barrier is formed against an opening being made into the peritoneal cavity; and, as the ulceration deepens, its base is formed of the structures to which the coats of the stomach adhere. It has been calculated by Dr. Brinton that 70 per cent. of the simple ulcers situated at the posterior surface are closed in by union with the pancreas or liver. But when this safeguard does not exist, the extension of the ulceration outwards finally reaches the peritoneum, this thin membrane sloughs, and a portion of the contents of the stomach escapes

into the peritoneal cavity. Sudden and violent peritonitis is immediately set up, which is almost always followed by fatal consequences. In some cases the opening into the peritoneum is found to be closed with lymph, so that peritonitis is not set up; and in others, instead of the contents escaping from the stomach, a mere leakage occurs through the peritoneum, which is sufficient to produce inflammation of the serous membrane. Hence it may happen that, instead of general peritonitis, circumscribed inflammation is set up by the perforation, and an abscess follows, bounded by the neighbouring organs, which have become closely united to each other and to the stomach. Some cases are recorded, where an abscess thus formed was evacuated through the lung by perforation of the diaphragm, the pus exciting in its passage gangrenous pneumonia or pneumothorax. In one case at the London Hospital the patient was suffocated by the sudden bursting of a perigastric abscess; in another a communication was established between the stomach and the external surface; in a third, the stomach became adherent to the duodenum; whilst in another the colon was perforated by the extension of a gastric ulcer through its coats.

Ulcerations situated in the anterior surface of the stomach are most apt to perforate the peritoneum, as the greater mobility of this region lessens the chance of adhesions taking place. Simple ulcerations are more apt to penetrate the serous sac than those of a cancerous nature, as adhesions are much more apt to occur in the case of the latter. Perforation again takes place more readily in the young than in those of more mature age, and it is especially liable to affect females. More than half the cases amongst females occur between the ages of fourteen and thirty, but in the other sex the effects of age are not so strongly marked.

Symptoms.—In cases of chronic ulcer, the symptoms produced by the perforation are preceded, for a more or less lengthened period, by pain, vomiting, or hæmatemesis. But in cases of acute ulcer the occurrence of perforation often takes place with startling suddenness, and the pain comes on when the patient believes herself to be in perfect health. In most instances careful inquiry shows that there has been previously slight uneasiness after food, flatulence, or other signs of disordered digestion. It is, however, important to recognise the fact that this terrible accident occasionally occurs where there has been no previous complaint of ill-health, so that any sudden and severe pain in the abdomen in a young person should never be treated lightly. In a large proportion of the cases admitted into a hospital, purgatives or stimulants have been previously given, and it has occasionally happened that castor oil, or some other medicine, has been detected in the peritoneal cavity on examination after death. The first symptom of peritoneal perforation is a sudden and severe pain in the abdomen, and this is not necessarily referred to the region of the stomach. It is quickly followed by retching or vomiting; and when the patient is seen by the practitioner, the symptoms of general peritonitis are present in a marked degree. The patient lies upon his back, with his knees raised, dreading to make the slightest motion, speaking only in a slow and guarded manner, and breathing quickly and carefully, lest the action of the diaphragm and abdominal muscles should increase his suffering. The face is pale, covered with a cold sweat, and expressive of suffering and anxiety; the whole abdomen tense, and so excessively tender that the slightest pressure is dreaded; the pulse is quick, small, and compressible; the extremities are cold; and the bowels obstinately confined. The patient may either sink in the stage of collapse, or the pulse may recover its strength, the extremities regain their warmth, and death may occur from peritonitis some days later. Occasionally peritonitis occurs without collapse. Well-authenticated cases of recovery are excessively rare. When perforation of the colon takes place from the extension of a gastric ulcer, the pain is often very severe, from the co-existence of peritonitis; and the sudden appearance of fæces, or of fœtid gas, in the vomited matters, indicates the presence of an opening into the large intestine. In other cases, the communication between the organs appears to be of a valvular kind, so that severe diarrhœa may occur from the entrance of the gastric contents into the gut, without any appearance of fæculent matters in the fluid rejected from the stomach. Where perforation of the diaphragm has taken place, there has usually been severe febrile action, with great pain in the side or epigastrium, followed, after an interval of some time, by the symptoms and physical signs of pneumothorax or gangrenous pneumonia. As gas usually escapes from the perforation into the peritoneal cavity, there is generally a great and uniform swelling of the whole abdomen; and the normal dulness of the liver is replaced by a tympanitic sound, from the organ having been pushed backwards by the gas. Former adhesions, however, between the liver and the parietes of the abdomen may prevent the appearance of this latter sign; and, on the other hand, coils of distended intestines may overlap the liver, and so present a tympanitic sound on percussion, when perforation has not occurred. In the latter case, the abdominal swelling is not so uniform as in cases of perforation. If the patient should survive thirty-six or forty-eight hours, evidence of the presence of fluid in the peritoneum may be obtained. *See* 1*a*. Abscess around.

Diagnosis.—Peritoneal perforation is most apt to be confounded with colic, or the passage of a biliary or a renal calculus. In all these cases there is the occurrence of sudden and severe excruciating pain in the abdomen, often attended by vomiting; and all may be accompanied with great depression. In perforation, however, the patient lies in the recumbent position, with the legs drawn up; whilst in the passage of calculi or colic he is restless and tosses about. In the former the pulse is rapid, and there is intense abdominal tenderness; in the latter the patient often seeks, by pressure over the seat of the pain, to relieve his suffering, and the pulse is but little quickened. In perforation, there is often a history of symptoms indicating gastric ulcer; in colic, not infrequently, an account of previous attacks of a similar description.

Treatment.—The main chance the patient has of escape from death is in the most perfect rest, both of the whole body and of the digestive canal. Food and drink of every kind must be forbidden, and even enemata should be avoided. A full dose of opium must be administered—as much as two grains, and a smaller quantity repeated every two or three hours subsequently. Cold applications externally have been recommended, but it will be generally found that warm fomentations give more relief. If improvement take place, it will be better to support the strength of the patient for some time by nutrient enemata, than by food given by the mouth.

Many cases are now on record where surgical treatment has been resorted to when perforation of the organ has been diagnosed. But although the performance of abdominal section is simple, the task of discovering a small perforation in the posterior wall of the stomach and in the midst of the numerous soft adhesions which co-exist, has mostly rendered the operation unsuccessful. Several times, when the perforation occurred in the anterior wall of the organ, it has been found, and the edges of the aperture carefully united by stitches; but in almost every instance the patient eventually succumbed. It may be, however, that when the diagnosis of perforation can be made with greater certainty, and the operation undertaken at an early period, a greater measure of success may attend what is at present merely a forlorn hope.

19. **Stomach, Softening of.** — There are few stomachs examined after death, more especially during the warmer months of the year, that do not show some signs of softening. When this change is only slight, the surfaces of the rugæ alone seem softened, and have a semi-transparent appearance. When it is more extensive, the whole of the lining membrane covering the fundus has a smooth, thin, translucent appearance, and is either readily detached by the finger, or forms a slimy mucus overlying the subjacent coats. Where the process has proceeded still farther, the muscular and peritoneal layers are soft and pulpy; and occasionally the organ is perforated, and the contents are found in the cavity of the peritoneum. More rarely still, the softening affects the neighbouring organs, the œsophagus or diaphragm being perforated; and the gastric contents may be found in the left pleura. The nature of this process has given rise to no small discussion. John Hunter, who first remarked its occurrence in healthy persons who had been killed by accidents, attributed it to the action of the gastric fluid upon the stomach after death. Some pathologists of eminence, whilst admitting that softening may result from *post-mortem* solution, contend that certain forms of this condition occur during life and differ in their character from cadaveric changes. Rokitansky distinguishes two primary forms of softening: one a disease of infant life, called *gelatinous* softening, in which the whole fundus is converted into a greyish, transparent jelly, and which is usually an accompaniment of cerebral affections; the other, in which the parietes of the stomach are converted into a dark-brown pulp, occurs either in diseases of the brain, or as a sequela of typhus fever, pyæmia, acute tuberculosis, acute cancer, and other diseases. One chief cause of difference in the appearances of these forms is the state of the blood-vessels. In the first the pallor arises from the anæmic condition of the lining membrane; whilst in the latter the dark-brown colour is probably dependent on the action of the acid upon the blood contained in the distended veins and capillaries. Notwithstanding the authority of the distinguished pathologist just named, it is generally believed at the present day that all the various forms of softening are merely the result of *post-mortem* digestion, and that the differences in appearance between them are only the effects of the varying amount of acid that may exist in the stomach at the time of death.

Certain circumstances have been found to favour the occurrence of *post-mortem* softening of the stomach: (1) The condition of the atmosphere at the time of death is one element. It was in summer that the cases occurred that first attracted the attention of Hunter, and it is found that the extent of softening which occurs in cold weather is comparatively trifling to what is observed in the warmer months of the year. This is what might have been anticipated, for we know that heat is requisite in order that artificial digestion should proceed quickly. (2) The amount of the contents of the stomach exercises a considerable influence. When death has occurred whilst the stomach is empty, little or no softening occurs, but if it contain food the mucous membrane is sure to present some indications of change. (3) The nature of the contents of the stomach is still more important in determining the amount of softening. It is well known that the presence of an acid in the gastric juice is requisite for the performance of digestion, and we consequently find that there is the greatest extent of change where there is a large amount of acid in the contents of the stomach at the time of death. This fact has been ingeniously used to explain why the *post-mortem* changes are so extensive, as remarked by Rokitansky, in disease of the brain and in the case of children. It is believed that an unusual amount of acid is secreted in cerebral affections, as we know is the case in certain irritations of the liver and kidney; and as the food of children is mostly composed of milk, it is assumed that the lactic acid resulting from its decomposition, united with the pepsin contained in the stomach, forms a digestive fluid possessing great activity. (4) The condition of the stomach as regards the amount of pepsin stored up in it exercises a considerable influence upon the chance of its softening. It has been elsewhere shown that in typhoid fever, chronic atrophy, and chronic hyperæmia, the amount of pepsin stored up in the gastric mucous membrane is very small, and it is in these disorders that we meet with very little alteration in the organ after death. (5) Another point, which has not attracted sufficient notice, is that the texture of the organ varies in different cases, and that some stomachs more readily yield to the solvent action of the gastric juice than others. To prove this the writers placed in an artificial digestive fluid equal portions of three human stomachs. The first was normal; the second in a state of fatty degeneration; whilst, in the third, the gastric tubes were replaced by fibrous tissue, and the blood-vessels were much congested. After a few hours' digestion the first piece was found reduced to a pulp; the second was gelatinous, and of a yellow colour; the third formed a black, opaque mass, quite unlike the others. Here, it will be observed, the colour and appearance of the different specimens varied; and in many cases, as for example in children, the softness of their healthy mucous membrane greatly determines the rapidity and completeness with which the gastric fluid acts upon it. To ascertain if this were correct, four pieces of stomach were placed in very dilute hydrochloric acid. The first was taken from a healthy dog and was soft; the second from a healthy human subject; the third and fourth from women who had died from cancer of the breast, the mucous membrane of whose stomachs was extensively atrophied. After three hours' digestion at 100° F., the first broke up into fragments; the second was reduced to a pulp; whilst the third and fourth showed only a little softening on their surfaces, but were in other respects unaltered. The completeness with which the first two were dissolved was found, from other experiments, to have partly arisen from the acid being imbibed by the tissue, and coming into contact with the pepsin stored up in the gastric cells, which were absent in the diseased structures of the third and fourth specimens.

Softening of the mucous membrane of the stomach may also occur without *post-mortem* solution. During the continuance of the cattle-plague the animals affected were killed, and in some cases the stomachs were immediately removed and brought to one of the writers. In each case the mucous membrane was very soft, and presented, under the microscope, the usual appearances of acute gastritis. Again, in certain disorders—as, for example, in cancer of the uterus—the gastric mucous membrane is very soft, even when there is no appearance of cadaveric change. This softness probably arises from imperfect nutrition, and is analogous to the fatty heart so commonly met with in such cases. Fatty degenerations of the stomach are by no means uncommon—for instance, the whole membrane has been found in this state in a case of gastric ulcer; and we can scarcely suppose that an organ in such a condition can have the same firmness as when the glandular texture is in a perfectly healthy state.

20. **Stomach, Syphilis of.**—The fact that syphilis ever affects the gastric mucous membrane is denied by many authors, and is very generally overlooked by practitioners; but the subject is so important from a practical point of view, that it seems necessary to devote some attention to its consideration. In the *post-mortem* records of the London Hospital three cases of ulcer of the stomach are mentioned, of which one presented old syphilitic ulcers on the leg; in another there was a syphilitic testis along with fibroid changes in the liver and kidney of a syphilitic nature, and also fibroid disease at the apices of the lungs; whilst in a third there was also a syphilitic affection of the testis. But in a considerable number of cases there were, along with chronic gastric ulcer, fibroid changes in the lungs, liver, or kidneys; and where a number of organs are thus simultaneously affected, the writers have usually been able to obtain a history of syphilis. Chronic gastritis of an obstinate character often shows itself in those who have suffered from syphilis; and in such cases, as well as in chronic ulcer, the most marked relief is frequently afforded by the administration of the iodide of potassium. The fact that chronic ulcer, with hypertrophy of the stomach, is apt to occur in advanced cases of tertiary syphilis had been noticed by Virchow, Leudet, and Lancereaux. Gummata have also been found situated in the submucous tissue in the

neighbourhood of the lesser curvature, and in close proximity to a cicatrix of an old ulcer (Cornil). Engel states that 10 per cent. of all chronic gastric ulcers are preceded by syphilis, whilst Lang asserts that 20 per cent. of all ulcers occur in syphilitic subjects. On the other hand, Chvostek only found one case of syphilis among 143 instances of duodenal ulcer. Although there is thus a considerable difference of opinion respecting the frequency with which gastric disorders follow the infection of syphilis, the practitioner will do well to bear in mind the possibility of its occurrence in any chronic case that has proved rebellious to ordinary treatment.

21. **Stomach, Tubercular Disease of.** The occurrence of ulcer of the stomach in persons who have died of phthisis has been already mentioned; but as the subject is of practical importance, some further observations seem necessary. Ordinarily the ulcerations are not of a tubercular character. Tubercular disease of the stomach is indeed very rare; only two have been found out of two thousand *post-mortem* examinations on cases of pulmonary phthisis (Soltau Fenwick). Amongst the cases on record the greater number have occurred in children. The disease is never primary; but in every case which has been verified by a necropsy the lungs have been the seat of tuberculous mischief. In nearly every instance the intestine has been in an advanced state of disease; in fact, the affection of the stomach might be said to be the result of an intestinal tuberculosis progressing upwards. In two instances on record tuberculous peritonitis co-existed with the gastric lesion. This peculiar exemption of the gastric mucous membrane from tubercular invasion appears to depend upon two causes. In the first place, the acid secretion of the organ is prejudicial to the development of the bacilli (Koch); while, in the second place, the lymphoid tissue, which is always the favourite point of attack, exists only in very small quantities in the stomach, and is situated deeply in the mucous membrane. That children are more liable to the disease than adults may be explained by the fact that they almost always swallow their expectoration, and thus introduce large quantities of the bacilli directly into the stomach.

The disease commences by the growth of miliary tubercle in the submucous tissue of the stomach. The granulations increase in size, undergo central caseous degeneration, and by their coalescence form small areas of necrotic tissue, over which the mucous membrane is rapidly destroyed.

Certain characteristics serve to distinguish the tubercular from the simple forms of ulceration. In position they usually affect the pyloric end of the stomach, in the neighbourhood of the smaller curvature. They are seldom round in shape, being more generally oval or scalloped in outline. The edges are irregular and infiltrated; the base is yellowish in colour and granular in appearance; and they are usually shallow, seldom extending deeper than the muscular layer. Around the ulcer may be observed many solitary tubercles, varying in size and shape. The peritoneal surface of the ulcer is covered with miliary tubercle, which may also be seen arranged in radiating lines along the course of the efferent lymphatics. With the microscope the ordinary tubercular formation can be observed, with plentiful bacilli.

The *symptoms* of tubercular disease of the stomach are very equivocal. Occasionally fatal hæmatemesis has occurred; in other instances perforation has proved fatal. In one case a tubercular ulcer of the transverse colon formed a communication with the stomach—gastro-colic fistula (Oppolzer).

22. **Stomach, Ulcer of the.**—Ulceration of the stomach occurs both (*a*) in an *acute* and (*b*) in a *chronic* form, although the description of the disease, as usually given by authors, is based upon the latter alone.

(*a*) **Acute Ulcer of the Stomach.**—This form occasionally presents itself in infectious disorders, such as pyæmia, erysipelas, and typhoid fever. Out of 100 cases of gastric ulcer recorded in the *post-mortem* registers of the London Hospital, three had occurred after severe injuries to the limbs, and two after erysipelas. The ulcers were small in size, numerous, and scattered over the surface of the mucous membrane. They appeared to have commenced as hæmorrhages in the mucous membrane, the parts affected being afterwards removed, in all probability by the action of the gastric juice. Ulcerations of the duodenum following severe burns of the body were first described by the late Mr. Curling from cases observed in the London Hospital; and in two instances ulceration of the stomach is mentioned in the *post-mortem* records as being found in such cases. In the opinion of the writers, the ulcerations found in persons dying from pyæmia and erysipelas, as well as after burns, are due to the absorption of deleterious substances from the affected parts. Acute ulcers occur also in the later stages of heart-disease, especially where great congestion of the portal system has been produced by disease of the mitral valve. Here also the first step in the production of the ulcers is hæmorrhage into the mucous membrane. From the examination of a case of gastric ulcer occurring in the course of typhoid fever, the writers are disposed to believe that the morbid change commences in the solitary glands of the stomach, and to attribute the small perforating ulcers that occasionally occur in young persons to ulceration of the same structures.

SYMPTOMS.—Although pain is occasionally complained of in cases of acute gastric ulcer, this is by no means common. Even in the perforating ulcer of young females, pain rarely precedes the faintings or hæmatemesis which are ordinarily the first indications of the disorder. In other instances the symptoms of acute peritonitis present themselves suddenly in a person who supposed himself to be in perfect health up to the time of the attack; and on *post-mortem* examination a small ulcer is discovered which has perforated all the coats of the stomach, although the most careful microscopical examination fails to discover any evidence of mischief beyond the edges of the sore. The most common indications of an acute ulcer are persistent vomiting of mucus or mucus mixed with blood, or a severe hæmorrhage taking place suddenly from the stomach. There is often in pyæmia and cardiac cases tenderness on pressure, but this has not been observed by the writers either in typhoid fever or in the acute perforating ulcer.

TREATMENT.—As the ulcerations are the direct consequences of other maladies, treatment can only be directed to relieve any dangerous symptoms to which the ulcers may give rise. Hæmatemesis requires the use of ice and astringents, whilst peritonitis arising from perforation should be treated according to the methods recommended for that disorder.

(*b*) **Chronic Ulcer of the Stomach.** ANATOMICAL CHARACTERS AND PATHOLOGY.—Chronic ulcerations of the stomach are of frequent occurrence, being present, according to the researches of Dr. Brinton, in about 5 per cent. of the deaths arising from all causes. The ulcers are usually round or oval, varying in size, as a general rule, from the diameter of a fourpenny-piece to that of a half-crown. They have been found to destroy life when so small that the most careful search was necessary to ascertain their existence, and, on the other hand, they may be met with many inches in diameter. When of recent formation, the edges are sharp, and the sore looks as if a portion of the mucous membrane had been punched out; but when the ulcer has lasted for some time, the edges are hard, callous, and adhere to the subjacent tissue. The diameter of the ulcer usually lessens from above downwards; so that, in case the peritoneum has given way, the perforation may be a mere chink. The base of the ulcer may be formed either of the muscular coat or peritoneum, or of some of the neighbouring organs—such as the pancreas, liver, or spleen—which have become attached to the stomach by adhesions. Microscopically, in recent cases the writers have generally found the tubes around the ulcer healthy, with the exception that a few blood-globules are extravasated amongst them. In older cases, the surrounding tissues are matted together, and the tubes are compressed and atrophied, whilst the newly formed fibrous tissue closely unites the edges of the lesion to the parts below and around them. But the mischief is always confined to the neighbourhood of the ulcer, and we never discover a general atrophy of the secreting structures of the stomach, as in malignant disease. At the most, the mucous membrane presents the signs of fatty degeneration, or the usual appearances of acute or chronic catarrhal gastritis. Where the ulceration is spreading, the tubes immediately around it may be seen to be more or less emptied of their secreting cells, whilst their basement membranes have fallen together. Still farther off may be remarked tubes only partially filled with cells, and the mucous membrane is consequently thin and soft.

Gastric ulcers are most common in the pyloric region, being chiefly situated on the posterior surface, and near the smaller curvature. When two are present, it is not unusual to find them opposed to each other, as though they had been both produced by the same irritation. When an ulcer exists in the duodenum, it is very common to find one also in the stomach. The most common cause of death in gastric ulcer is perforation of all the coats of the stomach. This occurs most frequently into the peritoneal cavity, and consequently produces severe peritonitis. In rarer cases the ulceration spreads to some of the neighbouring organs, such as the pancreas or liver, or opens a communication between the stomach and the colon, pleura, or pericardium, or produces a perigastric abscess, by attacking adhesions already formed between the organ and some of the adjoining structures (*see* 18. Perforation; and 1*a*. Abscess around). In other instances one of the large blood-vessels may be laid open, and severe hæmorrhage result. Although hæmorrhage is more common than perforation, it is not so generally a cause of death. Ulceration more rarely causes death by producing alterations in the size of the stomach. Thus cases are recorded at the London Hospital where great dilatation had resulted from thickening at or near the pylorus, produced by the old ulcer; whilst occasionally the organ was greatly reduced in size by a cicatrix near the cardiac orifice, or in the smaller curvature. In some instances death has resulted from pyæmia, and abscesses have formed in different parts of the body.

ÆTIOLOGY.—The age of the individual is allowed by all observers to be one of the chief predisposing causes of gastric ulcer. Where the functions of the stomach are most actively performed, as in childhood, it is scarcely ever met with, the late Dr. Brinton having been able to find only two cases out of 226 in children below ten years of age. It becomes gradually more frequent as age advances. Females are more liable to the disease than males, in the proportion of three to one. The chief preponderance of liability amongst females occurs at the commencement and the cessation of the catamenia. In both sexes, want of food, mental anxiety, and other depressing conditions, have been referred to as tending to produce the disease in question. Many authors regard intemperance as one of the most potent causes. Although the writers have certainly seen the symptoms of gastric ulcer follow too free a use of alcohol, yet they have been greatly surprised to find how rarely the stomach has presented any signs of disease, beyond those of catarrhal gastritis, in a considerable number of persons who had died of delirium tremens. The action of corrosive liquids, such as the mineral acids, when swallowed, is not infrequently a cause of gastric ulcer; but if the first effects of the caustic are overcome, the ulcers thus produced usually heal rapidly. In other instances an ulceration is the result of a tumour pressing upon an isolated portion of the stomach or duodenum, or of the bursting of an abscess originating in some of the neighbouring structures. Occasionally the symptoms of ulceration follow a severe shock or accident, and there seems no reason to doubt that the mucous membrane may be torn or otherwise injured in this way.

The co-existence of various diseases with chronic gastric ulcer has attracted less attention than it deserves, as the subject is most important both in prognosis and in treatment. In the cases recorded at the London Hospital more than one-half presented some other visceral affection. Thus, in nine there was either cirrhosis of the liver or thickening of its capsule; in eight there was valvular disease of the heart; and in eight others there was cardiac disease, the exact nature not being specified. The spleen was noted as very small in three, and in five others it presented some other morbid change. Granular disease of the kidneys is mentioned in thirteen, and some other form of renal disorder in four others. Many authors have stated that persons suffering from phthisis are especially liable to gastric ulcer, and sixteen cases are noted in the hospital records in which there was tubercular disease of the lungs. In six of these the description points to the case being one of fibroid phthisis; and it is in the very chronic forms of this malady that the writers have generally encountered gastric ulcers. One of the writers of this article has shown that in most of the cases of ulcer in chronic phthisis there is lardaceous disease of the mucous membrane, and that the ulcer appears to arise from localised hæmorrhage into this tissue. In three instances distinct evidences of syphilis are mentioned as co-existing with gastric ulcer; and although doubts have been expressed as to how far ulcer of the stomach is ever the consequence of that disease, the successful treatment of many chronic cases with iodide of potassium seems to the writers conclusive upon the point. *See* 20. Syphilis.

There has been much difference of opinion as to the method by which gastric ulcers are produced. Some authors are fond of pointing out that sores of this character are confined to the stomach and duodenum, where an acid secretion comes in contact with the tissues; whilst in the remaining parts of the small intestine they are rarely discovered. Hence it has been assumed that they are dependent, in some way or another, upon the solvent action of the gastric juice; and the discovery that there is usually an excess of free hydrochloric acid in cases of ulcer of the stomach has been supposed strongly to confirm this view. But although there is no doubt that the gastric secretion is capable of dissolving any portion of the mucous membrane that has lost its vitality, there is no proof that any excess of acid is able to produce an ulcer, so long as the structures are in a normal condition. The various hypotheses that have been invented to account for the production of gastric ulcers cannot here be discussed; but we may fairly allow that, like ulcerations on the exterior of the body, they must originate from very different causes.

An acute ulcer often becomes chronic. It has been proved by experiments on animals that anæmia is sufficient to prevent the healing of a gastric ulcer; and as in cases of acute ulcer hæmorrhage is very apt to take place, we have in this a possible explanation of their tendency to assume a chronic form. As soon as the edges of such a sore become thickened, a still further impediment to cicatrisation is produced.

The death of small portions of the mucous membrane has been attributed to embolism of the arteries of the stomach. Against this, as a common cause, is the fact that the gastric ulcer is generally single, and that we constantly fail to discover ulcerations where numerous emboli can be shown to be present in the vessels of the other principal organs of the body. It is probable, however, that some rare cases are to be attributed to this cause.

Dr. Copland pointed out how often the arteries of the stomach were diseased where an ulcer was present, especially in old people. The truth of this remark the writers can confirm from the microscopic examination of a number of specimens, in which they found the arteries in the neighbourhood of ulcers thickened. It is evident that such a condition must diminish the supply of arterial blood, and therefore lessen the vitality of the part, and so produce a tendency to ulceration. In addition to this, as the cause is a permanent one, it would prevent cicatrisation; or in case healing of the sore should take place, it would confer a liability to a fresh attack of ulceration.

It was before stated that affections of the heart and of the liver are frequently discovered in those who had suffered from gastric ulcer, and it is often found that the veins are thickened and tortuous in the vicinity of chronic gastric ulcers. The retardation of the current produced by an increased pressure upon the portal system, or by a change in the venous circulation of any portion of the mucous membrane, is sufficient to account for the tendency to ulceration under such circumstances, and must also tend to prevent the cicatrisation of a sore when it has taken place.

The causes of gastric ulcers must also be sought for in changes in the mucous membrane itself. In twenty of the cases recorded at the London Hospital there is mention made of thickening at a distance from the ulcer; and, although in some this may have arisen from the irritation set up by the sore, it is not sufficient to explain them all. Thus, in one instance the sore 'seemed to be excavated in a thickened tissue, and had no thickened margin, the middle coat was hypertrophied a quarter of an inch thick, the tissue being hard and glistening.' In another case there were two ulcers, but there was also 'fibroid induration in patches scattered over the mucous membrane of the stomach.' When the frequency with which the microscope detects isolated patches of fibroid, fatty, or lardaceous change in stomachs that to the naked eye seem healthy is considered, there can be no doubt that no small proportion of chronic gastric ulcers originate from such changes in the tissues. It has been mentioned that a number of the cases of ulcer co-existed with contracting kidneys; and as the writers have proved that in this disease there is almost always a similar degeneration of the gastric mucous membrane, it seems probable that this is the reason of its occurrence.

Ulcers are apt also to occur whenever the circulation of the stomach is generally or locally impeded. Thus, in four instances in the records of the London Hospital an ulcer co-existed with dilatation of the stomach arising from stricture of the pylorus; and in one the sore was situated near to a fibrous tumour the size of a walnut.

Symptoms.—Pain is by far the most constant and prominent symptom of ulcer of the stomach. At first it is only a feeling of uneasiness after food, but as time goes on it increases in constancy and severity. It commences shortly after food, and persists during the whole period of digestion, or until the contents of the stomach are rejected by vomiting. In some cases it begins as soon as food has been taken, but more generally after an interval of fifteen or twenty minutes. The pain is usually relieved by the recumbent position, but in some cases the patient finds relief by bending the body over a chair or by lying on one side. In some cases of large ulcers there may be little or no pain, the sore being apparently insensible to irritation, as is sometimes seen to be the case in old ulcers of the legs. The pain is referred to one spot, which is usually situated in the epigastrium, but more rarely it affects the left hypochondrium or the umbilical region. In a considerable number pain is experienced in the back, usually at a place between the last dorsal and the first lumbar vertebræ, or rather a little to the left side of this region. The pain may increase for a few days, and then gradually subside. These exacerbations are chiefly observed in very chronic cases. They probably point to an extension of the ulceration, for they not infrequently precede hæmorrhage and perforation. In almost every case there exists tenderness on pressure over the seat of the sore. This may be so great that the patient is unable to wear his clothes moderately tight; in other patients it requires a careful search to discover the sore spot. The tender part is, as a rule, opposite the place to which the pain is referred, and can often be covered by the finger-end. General tenderness is no test of an ulcer, as it is often present in congested liver, gastric catarrh, and other complaints of the epigastric region. It is necessary to be careful in testing for the existence of a gastric ulcer by the finger, for a very slight pressure often suffices to bring on a paroxysm of pain, even when the stomach is empty of food. The tender spot is generally situated in the epigastrium, but may be in the hypochondrium, or near the umbilicus.

Vomiting, although often present, is a much more variable symptom. It seldom occurs directly after food, as is often the case in cancer, because the cardiac orifice is rarely the seat of simple ulcer. It is preceded by nausea, and not infrequently by a copious flow of saliva; and it relieves the pain by freeing the stomach of its irritating contents. The tongue may be perfectly clean, or may be thickly coated. As the abnormal appearances of the tongue in dyspepsia arise from an extension of gastric catarrh to the mucous membrane of the mouth, a perfectly clean tongue is present if the ulcer is unattended by gastritis. Flatulence is not a common symptom, inasmuch as the amount of food taken is limited, on account of the pain produced by it. Extreme acidity occasionally presents itself, but it is not so common as the statements of some authors would lead us to imagine. The appetite is seldom much affected, especially in the young. Patients often remark that they could and would eat freely, were it not for the dread of the pain. The bowels are generally confined. The stools are knotty, and in many cases contain mucus. There is nothing characteristic about the urine. It is usually clear; and is passed frequently, and in unusually large quantities. Whenever the disease has lasted for some time there is a loss of strength and energy, arising from imperfect nutrition, from the frequent attacks of pain, and from the vomiting.

The duration of gastric ulcer varies greatly. In some cases the sore seems to heal rapidly; whilst in others the symptoms often subside and reappear, so that the patient remains an invalid for years. Chronic cases in old people are often very difficult to cure, and great patience and perseverance are required in order to obtain even an alleviation of the symptoms. The symptoms produced by hæmorrhage and perforation are elsewhere described. *See* HÆMATEMESIS; and 18. Perforation.

Physical Signs.—In a recent case of gastric ulcer we can expect no assistance from physical signs, but where the disease has lasted for some time evidence of adhesions may be detected. Adhesions may be suspected, when it is found, by auscultation and auscultatory percussion, that only a small portion of the stomach is in apposition with the abdominal walls, and more especially if this part is the tender spot, and does not vary its position with different states of distension of the organ. Again, if the stomach is found to be of considerable size when empty, and its extent is not increased by food, we may suspect that its motions are trammelled by adhesions. The microscope affords but little assistance in the detection of gastric ulcer, because the extension of this disease is usually very slow, and we therefore have little chance of discovering portions of the mucous membrane in the vomited matters.

One of the most important points is the absence of tumour on palpation. No doubt in some instances the ulcer is accompanied by a certain amount of thickening, but it is only in rare cases that this can be discovered by the hand. The writers have for years been in the habit, in all doubtful cases, of administering one or two teaspoonfuls of common salt in half a tumblerful of water in the early morning before any food has been taken, on the supposition that where an ulcer is present the irritation of the salt would produce pain. In many instances pain referred to one spot has followed the exhibition of the salt, and when this has not occurred it has generally been subsequently found that the case was one only of dyspepsia. The salt has never produced any bad results, except retching, and in fermentative dyspepsia has usually proved beneficial. Various other fluids, such as dilute hydrochloric acid, have been tried, but have not succeeded so well as the chloride of sodium.

It has been recommended by Leube that a galvanic current (twenty to forty cells) should be passed from the spine to the stomach, in order to distinguish ulcer from neuralgic affections. It is said that pain is produced in the former; in the latter the pain, if present, is soon relieved. The writers have tried this plan, and in some cases of ulcer pain has followed the application; but the trials have not been sufficiently numerous to enable them to determine its value. In some instances tenderness has been discovered in the pneumogastric nerve in the neck, but this is rarely present in recent cases. In chronic ulcer there is almost always an increase in the amount of free hydrochloric acid in the contents of the stomach; but although in the case of a constant excess this may be useful in diagnosing ulcer from cancer, it is in other respects not applicable, inasmuch as vomiting usually comes on shortly after a meal, and the use of a stomach-tube is not advisable in this disease.

DIAGNOSIS.—It is generally said that ulcer of the stomach may be confounded with colic arising from gall-stones. In ordinary cases this mistake is not likely to occur, for the pain in ulcer is referred to the epigastrium; it is absent or moderate when the digestive process is finished, but is increased shortly after solid food; and it is relieved by vomiting. In gall-stones the pain is situated in the right hypochondrium; it is severe during each attack, but disappears afterwards; it is not influenced by the process of digestion; and it is not relieved by vomiting. In addition to this, there is no hæmatemesis in gall-stones; the gall-bladder can often be felt to be enlarged; and jaundice generally succeeds to an attack. It must not be forgotten that irritation of the gall-bladder may set up ulcer of the duodenum. One of the writers has seen a case where uneasy pain was constant, was increased after food, was relieved by vomiting; and on *post-mortem* examination there was no ulcer, but only a vastly dilated gall-bladder, the exit of which was blocked by a calculus.

The diagnosis from cancer, atonic dyspepsia, and neuralgia is considered under these separate headings in the present article.

TREATMENT.—The main indication, where the symptoms of ulcer of the stomach are urgent, is to give to the affected organ as perfect a state of rest as is possible. The patient must be placed in the recumbent position, unless it produce pain, and must retain it strictly. In chronic cases, or when the more severe symptoms have subsided, a limited amount of exercise may be permitted, lest the general health may become deteriorated by confinement. In urgent cases mere position is not enough, and physiological rest must be ensured. It is, therefore, often necessary to interdict the use of all food, and to keep up the nutrition of the body by nutritive enemata. This should, however, never be continued longer than is necessary to subdue the more urgent symptoms, as the strength of the patient soon fails when rectal alimentation forms the only means of support. In less severe cases it is only necessary to confine the patient to liquid food, taken in small quantities and frequently. Milk, if it can be digested, should form the basis of the diet, and it can be either taken alone, or, if there be much acidity, mixed with lime water or with Seltzer or Vichy water. In some cases buttermilk agrees, where sweet milk produces vomiting. In others the concentrated Swiss milk is more readily digested. But sometimes milk in all forms disagrees, unless it be mixed with some farinaceous material, such as arrowroot, sago, tapioca, or cornflour. In many instances peptonised food is of value.

Leube recommends that the diet of the patient should consist, at the start, of one pot of beef solution *per diem*, corresponding to half a pound of beef; and to this he usually adds, for breakfast and dinner, some milk and a few pieces of rusk, which should not be swallowed until they have been thoroughly softened and masticated. The beef solution is taken pure, or it may be stirred into *bouillon* with a little of Liebig's extract of meat, and a little salt added, or not, as desired. As the patient improves, a more nutritious diet may be prescribed, such as beef-tea, mutton-broth, chicken-broth, eggs, macaroni, or light puddings, followed by fish, sweetbread, chicken, and finely scraped beef, lightly cooked; but all irritating food, such as brown bread, oatmeal, green vegetables, and fruit, must be prohibited. Where the patient is young and otherwise healthy, leeches are often of great service. Some practitioners have objected to their use, but the writers have often seen them of signal benefit. It is seldom necessary to apply more than six at a time, and they may be repeated from time to time as the case requires. In other cases dry-cupping answers a good purpose. Where there is reason to object to the effects of the leeches, a bladder filled with ice and applied to the part may afford relief; but, in general, hot poultices and fomentations are more useful. In long-standing cases great benefit is often derived from repeated small blisters, or from the application to the epigastrium of tartar emetic ointment or croton oil. The most valuable remedy in all cases is opium. It relieves pain, controls the action of the muscular coat, and restrains the secretion of the stomach. It is best given in doses of one or two grains, once or twice a day, shortly before food. It is a common practice to administer morphine hypodermically, but this in some cases produces vomiting, and must therefore be used cautiously. Besides this, it must be remembered that the sedative, when taken by the mouth, is more directly applied to the ulcerated and tender surface. The vomiting is a most distressing symptom, and tends to prevent the healing of the sore. The fluids rejected should be often examined by the microscope. If torulæ or sarcinæ are present, recourse must be had to carbolic acid, creasote, or sulphurous acid; at the same time a small blister should be applied to the epigastrium. Bismuth is the remedy usually given whenever gastric ulcer is suspected to be present, but it acts best where a considerable quantity of mucus is discharged by vomiting. In ordinary cases opium is more efficacious, and may be combined with the bismuth and with soda or magnesia. As soon as the more active symptoms subside, iron or some other tonic may be prescribed, but the least irritating preparations of iron should be preferred, such as the saccharated carbonate or the ammonio-citrate. Some practitioners prefer small doses of the tincture of the perchloride well diluted with water.

When the case is still more chronic, preparations of silver, copper, and zinc have been recommended. The nitrate of silver is, in the opinion of most authors, to be preferred, whilst others have looked upon it as inert in the doses usually given. The writers have certainly seen great benefit both from it and from the sulphate of copper; but, on the other hand, serious mischief may result from the administration of these salts at too early a period. As the bowels are almost always confined in gastric ulcer, it is necessary to promote their action by castor oil, small doses of aloes, enemata, or glycerine suppositories. In the more acute stage of the disease all irritating aperients must be, of course, carefully avoided, and the bowels should be relieved only by enemata.

Of late years Carlsbad salt has been strongly recommended as an aperient, under the idea that it will remove any gastric catarrh which may be associated with the ulcer, but the writers' experience of it has not been favourable. Whenever syphilis is suspected, the iodide of potassium may be used. It is best to commence with a small dose, and augment it gradually. Some cases that have resisted all other treatment rapidly improve under the drug, pain and vomiting disappear, and the patient gradually regains flesh and strength.

The stomach tube was used in cases of ulcer shortly after this method of treatment for gastric disorders was introduced, but in the writers' opinion it is unfitted for ordinary cases. Hæmorrhage has followed its employment in some instances, probably not so much from the mere contact of the tube with the sore, as from the severe retching that is often produced by passing it. They have, however, found it of value in some very chronic cases, where dilatation co-existed with the ulcer, the removal of the fermenting contents of the stomach appearing to favour the cicatrisation of the sore.

In case of severe hæmorrhage from a gastric ulcer, it would appear to be easy to perform the operation of laparotomy, and apply a ligature to the vessel at some distance from the point of ulceration. But it is well known that any interference with the vascular supply of the stomach is rapidly followed by softening and perforation of the coats of the organ, from the action of the gastric juice on the devitalised tissue. Consequently any attempt to ligature the bleeding vessel, except at the exact site of ulceration, would probably prove disastrous in its results, while from the fact that, in order to expose the bleeding point, the stomach must be opened, the only feasible operation would be an exceedingly hazardous undertaking. It must be noticed, however, that in one case of severe gastric hæmorrhage, Milkulicz is said to have opened the stomach, exposed the site of ulceration, scraped it, and cured his patient. Such an operation is at present unique.

23. **Stomach, Vessels of, Diseases of.** The blood-vessels of the stomach are frequently diseased, and their morbid conditions no doubt play an important part in the production of anatomical changes in the other structures of the organ. Dr. Copland, many years ago, drew attention to an atheromatous state of the arteries as frequently present along with gastric ulcer, and the same remark has since been made by Virchow. From repeated examinations of cases of chronic gastric ulcer with the microscope, the writers can confirm the truth of these statements. They have constantly found the arteries thickened and enlarged in the neighbourhood of the ulcer. Not infrequently the vessels, as well as the other textures of the organ, are in a state of fatty degeneration, the condition being in some degree analogous to what is observed in fatty degeneration of the heart, in connexion with obstruction of the coronary arteries. Where the arteries are healthy in gastric ulcer, the veins of the mucous membrane are generally thickened and dilated, displaying a state like that so constantly remarked in the veins of the lower extremities where ulcers have been long existing. In cancer of the stomach, the smaller arteries in the neighbourhood of the malignant growth have been often found greatly thickened. This condition no doubt leads to the rapid ulceration and sloughing that are such constant accompaniments of malignant disease in this organ. Still more extensive affection of the blood-vessels of the stomach is met with in lardaceous disease, inducing superficial ulcerations in the pyloric region, and diminution in the secreting powers of the mucous membrane.

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STOMACHICS (στόμαχος, the stomach).
SYNON.: Fr. *Stomachiques*; Ger. *Magenmittel.*

DEFINITION.—Substances which increase the functional activity of the stomach.

ENUMERATION. — The most important stomachics are Alcohol, Acids, Alkalis, Aromatics, Arsenic, Bitters, Pepsin, and Strychnine or Nux Vomica.

ACTION.—In the act of digestion the stomach has the threefold function of secretion, movement, and absorption. By an abundant secretion of gastric juice some of the albuminous constituents of the food are quickly digested; and this digestion is aided by the movements of the stomach, which mingle the gastric juice with the food, and aid solution by breaking up the particles. From the stomach, also, absorption of some of the products of digestion goes on. Some stomachics, such as alcohol and dilute alkalis, increase the secretion of gastric juice; possibly also bitters, and small doses of arsenic. Dilute acids, given after meals, and pepsin supply the essentials of gastric juice when secretion is deficient. It is not improbable that the peristaltic movements of the stomach are increased by strychnine and nux vomica. We want experiments on the action of drugs which increase absorption. It is also probable that some of the good results of bitters are due to their preventing abnormal processes of fermentation in the stomach.

T. LAUDER BRUNTON.

STOMATITIS (στόμα, the mouth).—Inflammation of the mouth. *See* MOUTH, Diseases of.

STONE.—A popular name for calculus. *See* CALCULI.

STOOLS. — SYNON.: Fæces; Motions; Fr. *Excréments*; *les Celles*; Ger. *Stuhlgänge*; *Stühle.*

INTRODUCTION. — An examination of the fæces frequently affords valuable evidence of the condition of the organs engaged in the process of digestion, and furnishes important data on which to found a diagnosis and suggest a rational treatment. Not only may structural changes in the alimentary tract be discovered, but also the completeness of action of the various digestive juices be recognised. As with the examination of the renal secretion, a previous knowledge of the healthy characters of the fæces is an essential: this being granted, the investigation may be pursued on the same lines in both cases, as regards the general, microscopical, and chemical characters. Since, however, the characters of the fæces are much more directly dependent on the ingesta, their examination cannot be so valuable an index of tissue-change as is that of the urine.

I. **Physical Examination.—1.** QUANTITY.—This is extremely variable. Taking the normal average for an adult to be about 5 ounces daily, it may vary from 2½ to 10½ ounces. The quantity would seem to bear no relation to the size or weight of the individual, but is rather influenced by the quantity and kind of food taken, and by the activity of the secretions of the alimentary canal. With an average diet, it is estimated the fæces form one-seventh to one-eighth of the weight of the ingesta. As a rule, the amount is increased by a vegetable diet. In children it would seem the total daily amount is relatively slightly greater, whilst in old age there is an absolute diminution. When in disease the quantity is increased, it is chiefly of the fluid portion, whilst a diminution affects both the solid and fluid parts. The writer has noticed a class of cases of intestinal derangement characterised, among other symptoms, by the daily passage—especially in the earlier hours of the day—of several very large pultaceous stools, amounting to a total quantity several times in excess of the normal, and this without a large ingestion of food; the lower part of the ileum, the cæcum, and the ascending colon appear to be in a condition of chronic catarrh in these cases. Tea is said to diminish the quantity of the fæces (Chambers). *See* CONSTIPATION; and DIARRHŒA.

2. CONSISTENCE AND APPEARANCE.—Departures from the normal cylindrical shape are frequent, and depend very much on the existence of constipation or diarrhœa. In infants the evacuations should be unformed and of a pappy consistency. The contents of the bowels pass from a semi-fluid condition in the ileum to the firmer state in the colon, mainly from an absorption of fluid constituents; should there be any delay in the passage the motions are liable to become hard and nodular (scybala), and this may occasionally be extreme, the fæces having all the appearance of sheep's dung, and being passed with considerable pain. Certain drugs, such as vegetable astringents, and many preparations of iron, bismuth, or lead, tend to make the fæces hard and firm. On the other hand, an increased peristalsis is associated with motions of all degrees of fluidity. This is very marked in the various forms of irritation to which the intestinal mucous membrane is liable, from the simple effects of a saline purge to the extreme conditions of ulceration, as in typhoid fever or dysentery. The rate of passage of the intestinal contents, together with the amount of intestinal secretion, are the conditions determining the various degrees of consistency of the stools designated by the terms 'scybalous,' 'formed,' 'semi-formed,' 'pultaceous,' 'loose,' and 'fluid.'

The existence of hæmorrhoids, rectal growths, or an enlarged prostate, may be recognised by groovings and marks on the excrement. It is very common in cases of stricture of the colon to find the motions flattened and ribbon-like, or as cylinders much contracted in diameter. Such appearances, however, are by no means constant, for it has been clearly shown that a considerable stricture, even as low down as the junction of the sigmoid flexure and rectum, may co-exist with motions of normal appearance, the fæcal matter becoming remoulded below the seat of constriction. But the invariable occurrence of such contracted motions is strongly in favour of stricture. Occasionally, as in psilosis intestini, the motions are passed in a fermenting condition, presenting a frothy brown or yeast-like appearance, and containing sarcinæ, similar to certain vomits.

3. COLOUR.—This is dependent on stercobilin ($C_{32}H_{40}N_4O_7$), which is regarded as identical with hydrobilirubin (urobilin), a derivative of bilirubin ($C_{32}H_{36}N_4O_6$), the chief bile-pigment, and is subject to considerable variation even within the limits of health. The usual brown colour becomes much darker if the fæces be long retained, or with an exclusively meat diet; pale yellow with milk food, as seen in infants; while it tends towards a greenish tint when vegetables form the bulk of the food.

Unaltered bile-pigment is never found in healthy stools. The conversion of bilirubin into stercobilin, regarded by Dr. MacMunn as a process of intermediate oxidation, normally commences in the first part of the colon; but if from any cause—such as the use of aperients, or ulceration or other affection of the bowels—the intestinal contents be hurried along and a diarrhœa established, then bile-pigments, as such, may be found in the motions, causing the bright yellow colour of the well-known 'bilious stool,' and often leading to much smarting of the anus when voided. In dysentery, the presence of bile in the motions is frequent, especially staining the mucus which is so abundant in the motions of that disease; globules of mucus from the small intestine, similarly coloured, may be seen in the stools of typhoid fever. Other constituents of the fæces, such as the shed intestinal epithelium, may also be stained with unaltered bile under the same circumstances.

It is noteworthy that the meconium contains a considerable amount of the normal bile-pigments, bilirubin and biliverdin, but no stercobilin.

The principal alterations in the colour of the stools are—

(*a*) *Pale and colourless stools.*—All degrees of deficiency of colour may be met with, producing the so-called 'clayey' or 'putty-like' stools. This condition is seen in its most marked degree when the bile is absolutely excluded from the intestine, as from impacted gall-stone; the motions being unformed, lumpy, 'porridge-like,' or scybalous, and almost or quite colourless, frequently, however, accompanied by a small quantity of distinctly bile-coloured fluid, which is secreted by the mucous membrane of the bowel from the bile-laden blood. The causes of pale stools when there is no such obstruction to the bile-flow are varied and not always apparent. In children the explanation is sometimes to be found in the presence in the motions of a large proportion of undigested fat (derived from the milk food); in various anæmic states the fundamental deficiency of blood-pigment appears to be the cause, and this may account for the frequent occurrence of this condition in rickets. But there remain many cases in which such explanations do not apply, and for which the cause can only be definitely ascertained when we know more certainly than we do at present what becomes of the bile as regards its reabsorption and decomposition in the intestine. The occurrence of colourless or clay-coloured stools in cases where there is no perversion of the biliary secretion or of its discharge into the duodenum, but where disease of the pancreas has been proved to exist, has suggested 'that the formation of the colouring-matter of the fæces depends on the mutual reaction of the bile and pancreatic fluid, under the influences met with in the intestinal tract;' though what the nature of this interaction is remains unexplained (*see* PANCREAS, Diseases of). A remarkable case which was under the writer's care would tend to show that the production of clay-coloured stools, in cases where the bile reaches the intestine and there is no jaundice, is due to some interference with those changes in the bile which normally take place in the first part of the colon. The patient died from the remote effects of an accident in which he had been severely squeezed between the buffers of a train; for several months previous to death he suffered from constant diarrhœa, the motions being invariably copious and quite colourless. *Post mortem*, the cæcum was found to be represented by a quantity of inflammatory fibrous tissue involving the adjacent parietes, excavated in which were a series of irregular spaces and channels, by which continuity was maintained between the ileum and ascending colon, and outside the peritoneal cavity; down to the end of the uninjured ileum the bowel contents were of normal condition and colour (the patient taking almost an ordinary diet) and contained bile, but in the colon they were colourless, as voided, whilst in the segment of mesentery corresponding to the cæcum and commencement of the colon, the lymphatic vessels were outlined by black pigment, presumably due to absorption of the biliary colouring-matter from the damaged portion of the intestinal canal. Further support for this view is to be found in the character of the motions met with in psilosis of the intestine, they being large, formed, white, and acid in reaction. Since no disease of the liver or pancreas exists in this malady, it has been argued by Dr. Thin 'that the abnormal reactions of the intestine must produce abnormalities in the development of the bacteria normally present in the bowel;' and it is suggested 'that the normal colouring-matter of the stools, under the influence of abnormal bacterial products, either is not formed or is destroyed.' *See* PSILOSIS.

(β) *Black stools.*—This condition is well marked when blood has escaped into the stomach and passes through the bowels. The hæmoglobin is decomposed by the gastric juice, and its constituent iron is converted into the black sulphide by the sulphuretted hydrogen present in the intestines. Such stools may look like tar; or if they have been long retained they become hard and almost coke-like in appearance (*see* MELÆNA). Iron, bismuth, or charcoal taken internally will similarly colour the fæces; but if taken in only small quantities the motions are slaty rather than black.

(γ) *Green stools.*—These are of frequent occurrence in children, and their cause appears to be due to very different conditions. Sometimes the coloration is certainly due to the presence of biliverdin ($C_{32}H_{36}N_4O_8$), an oxidation product of the biliary colouring-matter bilirubin, and it not infrequently results from a dose of calomel. Such stools are likely to be excessively acid in reaction. The green motions of severe infantile diarrhœa, which are neutral or only slightly acid, and sometimes, though not always, very ill-smelling, are said to owe their colour, even if the disease itself be not due, to a green-pigment-producing bacillus, there being a deficiency or even absence of bile. Bright-green stools have been occasionally noticed in typhoid fever, especially it would seem when the first part of the colon is involved in the ulceration. Here, again, the coloration appears to be closely associated with an altered state of the cæcum and ascending colon, whereby the fæces are subjected to abnormal conditions—among other things, to an increased acidity. Recent observations of Pfeiffer, however, throw some doubt upon this point, and seem to show that in cases of infantile diarrhœa the normal acidity of the intestinal contents is replaced by an alkaline condition, to which the green coloration is really due, though the fæces as voided may be acid from secretions of the colon. It is certainly the case that green stools in such cases are often rendered normal in colour by the administration of mineral acids.

(δ) Certain articles of diet and drugs are liable to colour the fæces more or less distinctly. Thus spinach, coffee, claret, and logwood impart to the excrement their characteristic tints; rhubarb, senna, and santonin cause a bright-yellow colour; and much cocoa may make the stools grey.

4. ODOUR.—The characteristic odour of the fæces is chiefly due to certain substances, especially skatol, and to a less degree indol,

developed during the pancreatic digestion of proteids, and partly to special secretions from the glands of the colon. Impaired intestinal digestion, particularly, it would appear, if there be any abnormal bacillary action, is apt to cause fœtid stools, but this is very variable. Absence of bile from the alimentary canal, by interfering with the pancreatic digestion, and also by the want of its own special anti-putrescent power, is often, but not always, accompanied with very ill-smelling motions. In certain diseases of the colon, as dysentery, the evacuations are of a most foul and acrid character, owing to putrid changes in the sloughs thrown off from the ulcerated bowel. In children, the alvine discharges are frequently offensive from errors in diet, and emit a peculiar sour odour.

5. Reaction.—The reaction of the fæces in health may be slightly acid, or slightly alkaline. This variability is due to the nature of the food, and still more to the extent and character of the changes in the colon. The stools in some diseases, as typhoid fever, are distinctly alkaline, and in others, as infantile diarrhœa, markedly acid; the colourless stools in obstruction of the bile-duct are also very acid from a large excess of free fatty acids.

6. Foreign Bodies.—By inspection of the evacuations we may discover—

(*a*) Substances *accidentally* swallowed, such as coins, pins, &c.

(*b*) *Indigestible food residua*, such as fish-bones, the stones, skins, and peel of fruits, fig seeds, the ligneous grit in pears, &c. Small seeds and particles of vegetable tissue, if long retained in the canal, may become encrusted with lime-salts, and, if abundant, form what has been called intestinal sand (*sable intestinal*).

(*c*) *Undigested food*, that is, portions of food that have escaped digestion. In certain severe disturbances of the digestive functions some of the food may be passed scarcely, if at all, altered, and may be easily recognised. This condition, known as 'lientery,' is especially prone to occur in the intestinal catarrh of young children during dentition. Curdy lumps derived from milk, and consisting of undigested masses of coagulated casein entangling fat, are often met with in infantile diarrhœa. 'On a moderate diet unaltered proteid is never found' (Halliburton).

(*d*) *Fat.*—This special element of the food may occur in the motions in such quantity and in such forms as to require separate mention. Anything more than a trace in the fæces is to be regarded as abnormal, and as the expression of a failure in its digestion or absorption. This may be due to an excessive ingestion, as may occur in a milk diet, or where undue quantities of olive or cod-liver oil are given for medicinal purposes; or to a deficiency of the digestive fluids, especially the pancreatic juice. The presence of fat in the stools has long been known as a diagnostic sign of pancreatic disease (*see* Pancreas, Diseases of), and of not infrequent occurrence in diabetes. In those morbid states characterised by extensive destruction of the epithelium of the small intestine, fat may appear in the motions from not being absorbed, although the quantity taken may be but moderate, and the conditions for its digestion unimpaired.

The form in which fatty matter appears in the stools is very variable, and much depends upon the kind of fat taken. Masses of almost pure fat may be found; or lumps of greasy-looking substances, consisting mainly of crystals of the fatty acids, or compounds of these with earthy bases, forming soaps, may be met with. Occasionally these substances may be voided in cylindrical form, which has been compared to macaroni.

(*e*) *Mucus.*—The amount of this substance in normal fæces is quite inappreciable, but in catarrhal and other inflammatory states of the lower end of the ileum and colon it is formed in considerable quantity. Its disposition in respect to the fæcal matter is, to a great extent, diagnostic of its site of production. Thus in catarrh of the ileum, with the very bulky stools above-mentioned, it is intimately diffused through the fæces in microscopic particles; in the motions of typhoid fever, bile-stained globules of mucus may be seen with the naked eye. It may be taken as a general rule that the more distinctly separate the mucus is from the excrement, the lower down in the bowel does it come from. When it occurs in masses adherent to or apart from the fæcal matter, it comes from the sigmoid flexure or rectum; whilst from the upper part of the colon the mucus appears as fair-sized globules mixed with the stool. In dysenteric inflammation and ulceration of the colon the mucus frequently forms discrete particles, which have been compared to grains of boiled sago or to frog-spawn, and may be mixed with pus and blood.

(*f*) *Blood.*—Blood voided *per anum* presents very different appearances according to its source. When coming from the stomach or upper part of the intestine it is much altered, being black and tarry (*see* Melæna). Even when recognisable as blood, there is a considerable range of variety in colour, as well as degree of admixture with the fæcal matter. On the one hand, it may be passed in a perfectly pure state, quite free from foreign matter, as would be the case when the bleeding took place from an eroded artery low down in the bowel, or even as high up as the ileum, provided the quantity were considerable, and it were discharged immediately after its escape. Practically, the purer and brighter the blood, the lower down is its source. Or it may occur as a brownish-red material thoroughly mixed with the fæces, and then comes from the commencement of the colon or small intestine; or streaks or smears of blood scarcely altered in appearance, with or without mucus, and attached to the surface of the motion, suggest a lesion in the lower part of the colon and rectum. The blood, from internal piles or extreme congestion of the venules of the rectum, has a characteristic purplish tint, and is frequently passed quite free from fæculent matter. *See* INTESTINES, Diseases of: 10. Intestines, Hæmorrhage from.

(*g*) *Pus.*—This is not a very frequent constituent of the stools, the amount in ordinary catarrhal states of the bowel being too small, as a rule, to be recognised without the microscope. In dysentery, however, the quantity is greater, and pus then becomes a prominent feature in the motions. When large quantities are passed, the source is usually an abscess which has burst into the canal.

(*h*) *Entozoa*, such as segments of tænia, the various round-worms, or the contents of hydatid cysts that may have burst into the canal, may be present in the fæces.

(*i*) *Miscellaneous.*—Under this head may be included *gall-stones, intestinal concretions, mucous or membranous casts of the intestines* (*see* CASTS: I. Of the Alimentary Canal; and INTESTINES, Diseases of: 13. Intestines, Inflammation of; Chronic Enteritis), *portions of bowel sloughed off from intussusception, or of new-growths, &c.*

II. Microscopical examination.—*See* MICROSCOPE IN MEDICINE: B. Fæces.

Concerning the micro-organisms of the fæces, it may be observed that they exist in vast numbers, and of many kinds, both in health and disease, but except the specific forms associated with cholera, typhoid fever, and tuberculosis, little clinical importance can at present be attached to them. Whilst cocci are more numerous in the solid evacuations, bacilli predominate in the fluid discharges. Among the latter the most abundant and most constant are Bacillus subtilis, Bacterium termo, Bacillus coli commune, and Clostridium butyricum.

III. Chemical examination.—The imperfect knowledge we possess of the actual chemistry of the tissues and secretions, with the exceeding variety in the composition of the ingesta, prevents our obtaining, from any analysis of the fæces, much information of a practical character. It is seldom if ever that such examination furnishes evidence of primary importance, as does analysis of the urine; it is only occasionally that the results correspond to what other signs and symptoms indicate to be the existing condition.

On an average the fæces contain about 23 per cent. of solid matter to 77 per cent. of water, but this proportion is liable to the widest variations both in health and disease, although the amount of water is little if at all affected by the quantity ingested. Thus in cholera-stools the solid residue may be but a few grains per pint. In many diarrhœal states the fluid portion of the stools is something more than a simple exudation, being partly of the nature of a true secretion.

The food is of course the main source of the constituents of the fæces, a few only of these constituents being derived from the bile.

For the chemical processes—often elaborate—required for their detection, reference must be made to standard works on physiological and pathological chemistry.

1. *Phenol* (C_6H_5OH), *indol* (C_8H_7N), and *skatol* (C_9H_9N) are normally formed in the intestines during the pancreatic digestion of proteids. A considerable proportion of these substances is absorbed, and, undergoing various chemical changes, is eliminated in the urine, but a sufficient amount of each leaves the body in the fæces, where they may be separated and detected by appropriate reagents. To skatol the odour of the fæces is mainly due, and it is said by Brieger to be absent from the evacuations of typhoid fever.

Leucin and *tyrosin*, which are also derived from the proteid elements of food by tryptic digestion, are not found in the fæces in health, though of frequent occurrence in the stools of various conditions of diarrhœa, especially cholera. *See* LEUCIN; and TYROSIN.

2. Two bodies—*excretin* and *stercorin*—have been described as characteristic of the fæces, but their existence is doubtful. They are non-nitrogenous, crystallisable, non-saponifiable bodies, differing in their crystalline form, and their solubility in alcohol and ether. They appear to be closely related to cholesterin, with which in many points they agree. It is said that when the bile which normally contains cholesterin is prevented reaching the intestines, neither of these bodies occurs in the fæces; and that they are also absent, being replaced by cholesterin, in the meconium, and in starving and hybernating animals, when there is no obstruction to the bile-flow. Flint considers about ten grains *per diem* to be the average amount of stercorin, and the excretin of Marcet to be about a fifth of that. *Cholesterin* itself, except in very small quantities, cannot be regarded as a normal constituent of the fæces; but the precise significance of its occurrence is uncertain. Its chief source is the bile, and only a small quantity comes from the food.

3. FATTY ACIDS, FATS, AND SOAPS.—Various members of the fatty-acid series, such as acetic, butyric, caproic, valerianic, and the higher terms, oleic, palmitic, and stearic, only occur free in minute proportions, in ordinary circumstances, but the latter are readily increased to considerable amounts when the alkaline secretions of the liver and the pancreas are prevented entering the intestines. The presence of neutral fats in the excrement may be taken to indicate that

there has been excessive ingestion or a diminished digestion, since under ordinary circumstances they would be absorbed. When occurring in considerable amount in the stools they produce the so-called 'fat-diarrhœa,' described in various dyspeptic states. The soluble sodium and potassium soaps ordinarily formed by the ingested fats with the bile and pancreatic juices should be in great part taken up by the lacteals; but fats, meeting with any calcium or magnesium salts that may be present in the alimentary canal, form with them insoluble hard soaps, which are passed in the fæces.

4. Salts.—These are but in small amount, and are chiefly the earthy and triple phosphates, with small quantities of iron and silica; there is in health a marked absence of chlorides. When the stools are very alkaline the triple phosphates may be very abundant, as in typhoid fever; and in cholera-discharges the whole amount of salts is largely increased, there being nearly an ounce in every hundred fluid ounces of evacuation, a large proportion of which consists of chlorides. A similar excess of these salts occurs in the stools of other diarrhœal states, with a corresponding decrease in the urine.

5. Pigment.—The characters of the fæcal pigments have been already referred to.

6. Mucin, Albumen, &c.—A very appreciable amount of *mucin* may be extracted from the fæces by well mixing with lime-water, and adding acetic acid to the filtrate.

Albumen, as such, can scarcely be looked upon as a normal ingredient of the evacuations; but the fluid part of cholera-stools, which resembles dilute blood-serum in composition, contains a very appreciable quantity. In typhoid and other diarrhœal stools albumen can be detected.

Peptones are not found in healthy fæces, but occur in considerable quantities in various diseases, of which the most frequent are typhoid fever, dysentery, tubercular ulceration of the intestines, and cirrhosis and carcinoma of the liver.

Ferments similar in action to ptyalin and pepsin are described as existing in the fæces, but how they may be modified in disease is quite unknown.

Certain of the groups of putrefactive bodies termed *ptomaïnes*, such as cadaverin and putrescin, have been recognised in the fæces.

In uræmia and also in intestinal catarrh *urea* has been detected in the stools.

In certain diseases, especially cholera, dysentery, typhoid fever, intestinal catarrh, both acute and chronic, and to a less degree hepatic and pancreatic affections, the stools are more or less characteristic, though the diagnosis rarely depends on their appearances alone. They are fully described, beyond the references to them in the present article, under their respective headings.

W. H. Allchin.

STRABISMUS.—Synon.: Squint; Fr. *Strabisme*; Ger. *Strabismus*; *Schielen.*

Definition.—A condition in which the two eyes are not directed to the same point in space.

Description.—Squint is commonly either (1) *convergent*, or (2) *divergent*; but (3) it may be complex, where there is a deviation either *upwards* or *downwards.* When one eye appears to be normally directed, and the other to deviate, it is convenient to distinguish the former as the *working*, and the latter as the *squinting* eye.

The extent or degree of strabismus, or, as it is more usually called, the *magnitude* of a squint, is expressed in terms of millimètres. In convergent or divergent squint it is customary to measure the distance between an imaginary vertical line bisecting the palpebral fissure, and another imaginary vertical line bisecting the pupil of the deviating eye. In an upward or downward squint, the distance between the horizontal diameter of the pupil, and an imaginary horizontal line bisecting the palpebral fissure, would give the measurement required.

1. Convergent Squint.—This is seen under two principal forms: (*a*) that which depends upon *paralysis* or paresis of one of the external recti muscles, permitting the antagonist internal rectus to exert a preponderating influence upon the position of the eye; and that which depends upon *excessive development* of both interni, in consequence of an error of refraction, whether (*b*) *hypermetropia*, or (*c*) *myopia.*

(*a*) *Paralytic Convergent Strabismus.*—This form of strabismus is met with in all degrees, from the slightest weakening of the affected external rectus to complete paralysis.

Ætiology.—Paralytic convergent strabismus is primarily a nerve-affection, in which, however, the muscle concerned will after a time be liable to undergo degenerative changes. The strabismus usually commences somewhat suddenly, in persons of adult age, and often rapidly increases in degree; the paralysis, which at first was only partial, becoming complete. In the great majority of cases it is associated with syphilis; but it is also met with as a result of impaired nutrition or degenerative change in the nervous centres, consequent upon anxiety or overwork. In some of the syphilitic cases, it appears to be due to central mischief, such as gumma or arterial occlusion; in others to pressure upon the trunk of the sixth nerve by periosteal thickening or other morbid growth.

Diagnosis. — In pronounced cases, the diagnosis is easy; and depends upon the fact that, even when the working eye is closed or covered, the squinting eye cannot be directed outwards by voluntary effort. If the paralysis, although considerable in degree, is not complete, the eye cannot be directed outwards as far as usual; if the paralysis is complete, the pupil cannot be carried external to the middle line of the palpebral fissure. When the affected muscle is only slightly weakened, the nature of the condition may not be at once apparent from the limitation of movement; and the degree of deviation may be so slight that it is not easy immediately to pronounce which eye is affected. This doubt may be removed, and the existence of paresis made manifest, by the following tests. The surgeon should stand in front of the seated patient, and should hold up before him, in the middle line and at a convenient reading distance, some small object, telling him to look at it steadily. By his own hand, or by a piece of ground-glass, the surgeon then cuts off the view of the object first from one of the patient's eyes and then from the other, watching their movements as he does so. When the object is concealed from the squinting eye, the other one, being already rightly directed, will remain stationary to continue the act of seeing, and the squinting eye will also remain stationary; but, when the object is concealed from the working eye, the other, or squinting eye, being wrongly directed, and not receiving the image of the object upon its yellow spot, will make a slight outward movement in order to take up correct fixation. At the same moment, the working eye, behind the obstruction, will execute an inward movement of somewhat greater amplitude than the outward movement of its fellow. Let it be supposed that there is slight weakening of the right externus, producing slight inversion of the right eye. When the object is screened from the right eye, the left still sees it clearly and sharply, and both eyes remain at rest. When the object is screened from the left eye, the right receives the image upon a point of its retina internal to its yellow spot, and sees it only indistinctly. The right eye, therefore, makes an excursion outwards, sufficient in amount to bring the image of the object upon its yellow spot, and to enable it to see better; but the motor impulse by which the necessary movement of the external rectus is called forth is conveyed at the same time to the internal rectus of the left eye, as a result of the habitual association of the two eyes and of their muscles in the act of looking towards the right; and the sound muscle, under a given motor impulse, contracts more vigorously than the weakened one. The result is that the excursion inwards of the working eye is larger than the excursion outwards of the squinting one; and in this way the fact of paresis of the right externus is rendered manifest.

This form of strabismus is at first attended by distressing double vision, which often produces giddiness, but which diminishes in time, as the patient learns to neglect or mentally to suppress the image of the squinting eye. The smaller the deviation, the more distressing will be the double vision; because, the nearer to the yellow spot is the image of the squinting eye, the more definite will it be, and the less readily will it be distinguished from that of the other. In cases of very slight deviation, the equality of the double images renders it difficult to tell the true from the false, and leads the patient into frequent error with regard to the position of the object looked at.

Treatment.—The treatment of paralytic strabismus is primarily that of the syphilis or of the nerve-exhaustion upon which the paralysis depends; but it is also necessary to endeavour to minimise the inconveniences of the double vision while it continues, and to provide against permanent degeneration of the paralysed muscle from disuse. The former indication may be fulfilled by covering the squinting eye with a patch, or with an opaque glass in a spectacle-frame; and, as the double vision is only troublesome when the eyes are directed to the side of the affected muscle, it is often sufficient to render opaque, by grinding or otherwise, the outer half of the glass which covers the affected eye. The nutrition of the muscle may be preserved, when the paralysis is incomplete, by systematic voluntary endeavours to call it into action; these endeavours being made three or four times a day for a few minutes at a time. For this purpose, the working eye should be closed or covered, and the squinting eye should be directed as much as possible towards the outer side. When the paralysis is complete, so that the eye cannot be carried beyond the middle line of its eyelid opening, it is necessary to exercise the affected muscle by localised electric currents, after the manner of Duchenne. In cases where there is no response to induced currents, those of a cell battery will sometimes be found effectual. The exercise by electricity should be repeated at short intervals, such as every two or three days, until the nerve-function is beginning to be restored, so that the muscle can again be exercised by the will.

In cases of paralytic strabismus of old standing, it is sometimes necessary to have recourse to tenotomy of the contracted internus, before the eye can be restored to its correct position. It may be laid down as a general principle that every case can be cured, by combined tenotomy and volitional or electrical exercises, as long as the paralysed muscle will respond, in however small a degree, either to the will or to one form or other of electric current; but that where the eye does not move outwards in obedience to the will, and where neither induced nor battery currents produce contraction of the paralysed muscle, no good is to be expected from either operative or medicinal treatment.

(*b*) *Convergent Strabismus due to Excessive Development of both Interni.*

Ætiology.—As a result of errors of refraction, about 90 per cent. of this class of cases are due to flat-eye or *hypermetropia.* The flat formation of the eye requires, for acute vision of near objects, a strenuous accommodation-effort; and this, by the intimate association which exists between the nerve-centres governing the accommodation muscles and those governing the interni, produces a corresponding effort of convergence. As soon as a child who is born with flat eyes begins to take careful notice of near things, his accommodation muscles and his internal recti are both called into frequent and energetic exercise; and the consequence is that the interni become excessively developed in relation to their antagonists, the externi, so that the normal, or resting position of the eyes, instead of being one of parallelism, becomes one of convergence. The result of this is that the child would receive double images, of equal intensity, of all objects situated either nearer to him, or farther from him, than the point at which the convergent optic axes would meet if prolonged. Let us suppose that this point is one foot distant from the eyes; and that the child wishes to look at an object which is eighteen inches distant. He cannot do this with both eyes, because the externi are unable to overcome their more powerful antagonists. If, however, he combines the right externus with the left internus, as in the act of looking to the right with both eyes, he becomes able to fix the object correctly with his right eye; and if he combines the left externus with the right internus, as in the action of looking to the left with both eyes, he becomes able to fix the object correctly with his left eye. But as, in either case, both eyes start from a position not of parallelism, but of convergence, the effort which carries the right eye from its convergent state to the middle of its palpebral fissure will carry the left from its convergent state to one of much greater convergence, and *vice versâ* with the left eye; so that, while one eye is directed to the object of vision, the other is rolled far inwards. In this way, the image is received upon the yellow spot of the working eye, and upon so peripheral a portion of the retina of the squinting eye that it is easily neglected by the consciousness, and ceases to be a source of confusion or embarrassment.

Diagnosis.—The state of things in an ordinary case of squint beginning in childhood is the following. In a state of rest, as when the attention is not directed to any object, or during sleep, or under an anæsthetic, the eyes are equally convergent; but as soon as any object is looked at, one eye fixes this object and the other rolls inwards. If the degree of flatness is alike in both eyes, and if the muscles in both are of equal power, sometimes one will be the squinting eye and sometimes the other; and in most cases this condition obtains for a time. The squint is then said to be 'alternating.' Generally speaking, however, it is for some reason easier to work with one eye than with the other; either because it is flat in a less degree, or because its accommodation muscle or its external rectus is stronger than the corresponding muscle of its fellow; and then this eye is used in preference to, and gradually supersedes, its fellow; becoming always the working, while that is always the squinting eye. The squint is then said to be 'permanent.'

Treatment.—It would appear at first sight, from the *rationale* of the affection, that the squint which depends upon flat-eye could always be prevented, or even cured, by the habitual use of convex spectacles; but, as a matter of fact, the balance of power between the externi and the interni becomes deranged at so early a period of life that spectacles could not be applied until too late. In every pronounced case of strabismus, it is necessary to perform tenotomy of the interni, sometimes only of one, but far more frequently of both; and the only question to be considered is that of the time most favourable for the operation.

In determining this question, the points chiefly to be taken into account are the state of vision, and the age of the patient. When a squint becomes permanent, the vision of the habitually squinting eye frequently becomes impaired, apparently as a result of the continued mental suppression of the image which it receives; and in a person who is suffered to grow up to adult age squinting, this impairment of vision often falls little short of blindness, and admits of no remedy. No change is discoverable, generally speaking, by the ophthalmoscope; but the power of responding to impressions upon the retina seems to be lost. On the other hand, as long as the squint is alternating, and each eye is used by turns, the sight does not usually suffer.

The immediate effect of tenotomy of one or both interni is to release the eyes from their position of enforced convergence, and to diminish the power of the interni to rotate them inwards. The divided muscles soon acquire new attachments farther back upon the eyeball than their former ones, so that their power is permanently diminished, and this diminution may even be in excess, so as to leave an undesirable preponderance of the externi, and a corresponding tendency to eversion. The surgeon, even by the best planned operation, cannot absolutely determine the future position of the eyes. That determination has to be effected by the muscles themselves under the guidance of vision; and a perfect result after a squint operation, by which is meant the restoration of parallelism when at rest, without impairment of the power of volitional convergence, can only be obtained by an instinctive rearrangement of the muscular forces concerned, a re-arrangement mainly brought about by efforts to avoid double vision, which is often the immediate result of an operation. While, therefore, it is always possible to remove by tenotomy a coarse and manifest malposition, it is only possible to command a perfect result when the recti muscles are well-developed, when the acuteness of vision is equal or nearly so in the two eyes, and when the power of attention to visual impressions is sufficiently active to render double images distressing. The muscular development and the power of attention are both deficient in early childhood; and hence, so long as vision does not suffer, it is better to defer operating for squint until about eight years of age. As long as the squint is alternating, there is no fear that the vision will suffer, and it is then safe and desirable to wait; but as soon as the squint becomes permanent, it is necessary to test the vision of the squinting eye from time to time, and to provide for this eye being exercised every day, by keeping the other closed or covered for short periods. If, in spite of such exercise, the vision of the squinting eye is found to be undergoing progressive deterioration, the operation should be performed without delay, at however early an age; and the parents should be warned that it may perhaps be necessary, for the attainment of perfect harmony of movement between the two eyes, to operate again at some future time.

It will sometimes happen that a child is first brought for advice at an earlier age than eight, in whom the squint has already become permanent in one eye, and in whom the vision of that eye has already begun to suffer. In such cases it is best to devote a few weeks to endeavours to improve the vision of the squinting eye by compulsory exercise; and, if these endeavours should be in any degree successful, to continue them as long as improvement under their employment is perceptible. If no improvement should be produced, the operation should be performed without further loss of time.

(*c*) *The Convergent Squint of Short-sighted People.*—This is not a very common affection, and depends upon the fact that, spectacles to afford distant vision not having been worn, the externi, which produce the approximate parallelism of the optic axes required for distant vision, have not been exercised; while the interni have been constantly exercised in producing convergence for the vision of near objects. The former muscles, therefore, have been suffered to fall into a condition of feebleness from disuse, while the latter have undergone abnormal development. In such cases the eyes are usually equally convergent, such a position giving single vision of near objects; while double vision of distant ones is not irksome, on account of the indistinctness with which they are seen.

Treatment.—When the convergent squint of a short-sighted person is of small magnitude, it may sometimes be cured by wearing glasses which correct the short-sight for distance, and call upon the external recti to take up their proper function. More frequently, however, they fail to respond; double vision is produced; and tenotomy, followed by the use of the spectacles, is required. Such cases usually turn out perfectly well.

2. **Divergent Squint.**—This is nearly always a consequence of defective vision of the squinting eye, which wanders outwards for want of guidance from visual impressions. It may also follow from unskilfully performed or excessive operations for the cure of convergent squint.

Treatment.—The operation for divergent squint is not a mere tenotomy, but requires the shortening of the internal rectus of the squinting eye, or its advancement to a point of attachment nearer to the corneal margin; and the results of such an operation are less under command than those of tenotomy. The muscle may not attach itself firmly in the new position, or the connecting medium may stretch after a short time. The operation may be undertaken more hopefully, the better the vision of the divergent eye; and it is often very successful. It is nevertheless most prudent, in every instance, to prepare the patient for the possibility of failure, or of only partial success. It is in no case likely that the defect will be increased by failure of the operation; and, as the chief motive for its performance is usually the improvement of appearance, it may be undertaken with propriety in almost every case.

3. **Complex Squint.**—The forms of strabismus in which the deviation is either upwards or downwards are not sufficiently numerous to be brought under any general rule. They depend either upon spasm of the muscle producing the deviation, or upon paralysis or paresis of its antagonist; and every case must be investigated and treated upon its merits, by tenotomy or electrisation, or both combined, according to the particular circumstances. Various irregular forms of strabismus are also seen, in the course of certain acute and chronic diseases of the nervous system, which entail loss or impairment of muscular coördination, such as meningitis and tabes dorsalis; but such forms are usually easily to be distinguished as symptoms of the general disorder, requiring no treatment or consideration apart from it. In chronic diseases, such as tabes dorsalis, it may be conducive to comfort to exclude the squinting eye from vision, for the purpose of obviating the inconveniences incidental to double images.

R. Brudenell Carter.

STRANGULATION (*strangulo*, I choke).—In pathology this term is employed to express either the process or the condition of constriction of a tube or pedicle, when it is so complete that the passage of the contents, or the circulation of the blood, is prevented. *See* Hernia; Intestinal Obstruction; and Ovaries, Diseases of.

STRANGULATION as a Mode of Death (*strangulo*, I choke).—Synon.: Fr. *Strangulation*; Ger. *Erwürgung*.

Definition.—The act and the effect of constriction of the neck and air-passages by means of a ligature or of manual pressure (throttling). Death results essentially from asphyxia.

Ætiology.—Strangulation is chiefly homicidal, but it may be suicidal or accidental. Accidental strangulation may occur in a variety of ways, as in the case of a child by tightening of a cravat round the neck, from the end catching in the wheel of a perambulator; in the case of a drunken woman by fixation and tightening of her bonnet-strings; and in the case of a cripple by a rope attached to a weight accidentally becoming tightened in front of the neck.

It was at one time doubted whether suicide could be effected by strangulation, owing to the fact that the hands relax when insensibility comes on, rendering it impossible to keep up sufficient tension on the ends of the ligature. But when the ligature is wound more than once round the neck, or some method is adopted by which the ligature can be tightened like a tourniquet, as by the insertion of a piece of stick which catches behind the ear or elsewhere, it is quite possible; and numerous instances are on record of suicide so effected. In most cases, however, the presumption is in favour of homicide, and in all cases of strangulation by manual pressure this may be looked upon as certain.

Signs.—In addition to the general indications of asphyxia (*see* Asphyxia), there are special signs of strangulation which vary with the degree of force employed, and the amount of resistance offered by the victim.

To strangle an individual of normal strength, and in full possession of all his faculties, is barely possible, without causing evident signs of violence on various parts of the body. The existence of injuries of this kind is valuable evidence of the mode of death. Very often cranial injuries are found, from the individual having been first knocked down by a blow on the head. Ecchymoses, abrasions, and other signs of mechanical violence are generally to be found in various parts of the body. If the strangulation has been effected by manual pressure, the front or sides of the neck exhibit bruised marks, corresponding to the thumb and fingers, with, perhaps, curved excoriations corresponding to the nails. The relative size of the marks produced by the thumb and fingers, and the direction of the nail marks, indicate the way in which the pressure has been exerted, and whether with the right or left hand.

When a ligature has been employed, a mark is left on the neck, which varies with the nature of the ligature and the way it has been disposed. Usually it is a transverse, shallow furrow; single, double, or multiple, according to the number of folds; and continuous, or interrupted in places; differing from that of hanging, which is generally single and oblique, and higher up in the neck. The bottom of the groove is generally pale, and not parchmented as in hanging, owing to the pressure not being kept up so long as to lead to desiccation. Ecchymoses in the course of the groove are met with more frequently than in hanging, owing to the great violence frequently exerted.

Very commonly punctated ecchymoses are visible on the conjunctivæ, face, neck, and chest. They are considered by Tardieu to be more frequent in strangulation than in asphyxia from other causes, or from overstraining, which likewise may lead to them. In the subcutaneous cellular tissue, and in the fasciæ of the muscles above and below the hyoid, extravasations are frequently found, as well as on the external surface of the thyroid cartilage and trachea. The lungs vary as regards their vascularity; but on the surface it is common to find pseudo-membranous patches, which are due to the rupture of some of the superficial air-cells and collection of air-bubbles under the pleura. In the substance of the lungs congested patches, or apoplectic extravasations, are often found, varying in size, according to Tardieu's description, from half a franc up to a five-franc piece—extravasations, therefore, much larger than those usually found in suffocation.

Treatment.—The treatment of asphyxia from strangulation is that of asphyxia in general. *See* Artificial Respiration; Asphyxia; and Resuscitation.

D. Ferrier.

STRANGURY (*στράγξ*, a drop; and *οὖρον*, urine).—Synon.: *Stillicidium Urinæ*; Fr. *Strangurie*; Ger. *Harnstrenge*.

Definition.—A spasmodic condition characterised by a frequent and urgent desire to pass urine, which is voided in drops or in very small quantities, with a sense of painful spasm in the perinæum and anus, and often unaccompanied with feeling of relief.

Ætiology.—Strangury can only be regarded in the light of a symptom, as the conditions which give rise to it are many and varied. It occurs in acute nephritis, in tubercular disease of kidney, in renal colic, and in cases of intense congestion of the kidneys, however induced. It is also a diagnostic symptom of poisoning by cantharides, either from the internal use of the drug, or the external application of cantharides plaster or of blistering fluid. It is also met with after the administration of large doses of turpentine and its allies. Many morbid states of the kidneys, ureters, bladder, prostate, and urethra own strangury as a symptom. Especially is it a symptom of acute inflammations of the prostate (abscess in particular); acute inflammations of the bladder; or when the trigone is involved by morbid conditions, such as vesical calculus, growths, and tubercular disease. When acute gonorrhœa involves the *deep* urethra, this symptom is likewise met with. It must therefore be remembered that strangury may be produced by any condition which, directly or indirectly, leads to inflammatory affections of the trigone, or deep urethra; and it is in this way that the affection accompanies stricture of the urethra, enlarged prostate, foreign bodies in the bladder introduced from without, or fæcal fistula.

Apart from inflammatory causes, morbid conditions of the urine, such as are met with in the oxalic and uric acid diatheses, may occasion strangury. Gouty prostatitis is therefore another factor in its causation.

Treatment.—The treatment of strangury is either preventive or curative. If it occurs during the administration or other use of drugs, such as turpentine or cantharides, it is imperative to discontinue their employment.

If we consider strangury as but a symptom of some other morbid condition, we must treat it as we should headache, cough, dropsy, or jaundice—remove the condition on which it depends. To relieve the more urgent and distressing local symptoms, we may have recourse to hot fomentations to the perinæum, warm sitz-baths, suppositories of morphine and belladonna, or the cautious use of hypodermic injection of morphine.

John Harold.

STRATHPEFFER, in Ross-shire.—Sulphur waters. *See* Mineral Waters.

STRICTURE (*stringo*, I bind).—A contraction of a tube, duct, or orifice, for instance, of any part of the alimentary canal, or of the urethra. *See* Urethra, Diseases of.

STRIDOR: STRIDULOUS (*strideo*, I creak).—Stridor is the name given to a peculiar noisy form of breathing, produced in the larynx, trachea, or main bronchus; varying greatly in its character—being either harsh, musical, or crowing; and due to various forms of obstruction. The term *stridulous* is applicable to the respiration, the cough, or the voice, when they possess the characters of stridor. *See* Croup; Larynx, Diseases of; Pneumogastric Nerve, Diseases of; Trachea, Diseases of; and Voice, Disorders of.

STROKE.—A popular synonym for an attack of apoplexy or sudden paralysis. It is also used in the compound words, *sunstroke*, *heat-stroke*, and *wind-stroke*, to indicate severally the sudden effects of these agents.

STRONGYLUS (*στρογγύλος*, cylindrical).—Synon.: Fr. *Strongle*; Ger. *Pallisadenwurm.* — A genus comprising many species of nematoid worms. The large kidney-worm, sometimes called *Eustrongylus gigas*, has only once been found in the human body. The case was undoubtedly genuine, and the specimen is still preserved in the museum of the Royal College of Surgeons of England. *See* Entozoa.

STRONGYLUS DUODENALIS.—*See* Entozoa.

STROPHULUS (*στρόφος*, a twisting of the bowels, or colic).—Synon.: Fr. *Strophulus*; Ger. *Schälknötchen.*

Definition.—A papular eruption of the skin in infants; referable, as the derivation of the word implies, to derangement of the bowels.

Description.—The eruption is a form of folliculitis, quite unimportant and unassociated with constitutional symptoms. Its principal seat is the face, but it may also be dispersed over the trunk of the body and limbs. Its duration will be influenced by the nature of its cause.

Some variety in colour, duration, and cause has given rise to several names applied to the eruption. It is sometimes ephemeral, and has been termed *S. volaticus*; sometimes the pimples are pale or shining, hence *S. albidus* and *S. candidus.* More frequently they are red and inflammatory, and either dispersed or aggregated, *S. confertus*; and occasionally an interpapular hyperæmia or inflammation gives rise to the variety known as *S. intertinctus.* When associated with dentition, this trivial rash is termed 'red gum' and 'white gum'; whilst under conditions of aggravation it is prone to run into eczema.

Treatment.—The treatment of strophulus consists in attention to the general health and condition of the infant. A few doses of magnesia and rhubarb, and even a grain of calomel, may sometimes be found useful, but in general a discreet attention to the food, with rest and warmth, will be all that is necessary. Locally, the rash should be dusted over with fuller's-earth powder, or sponged with a lotion of lime water and oxide of zinc, with or without calamine.

Erasmus Wilson.

STRUCTURAL DISEASES. — Diseases attended by recognisable anatomical organic changes, as distinguished from *functional* disorders. *See* Disease, Classification of.

STRUMA: STRUMOUS (*struma*, a scrofulous swelling).—Synonyms for scrofula and scrofulous. *See* SCROFULA.

STRYCHNINE, Poisoning by.—SYNON.: Fr. *Empoisonnement par la Strychnine*; Ger. *Strychninvergiftung.*—The seeds of *Strychnos nux vomica*, commonly known as *nux vomica*, as well as several other plants, owe their powerful toxic (excito-motor) properties to an alkaloid, *strychnine*; and in a minor degree to another alkaloid, *brucine*, which is said to produce the same physiological effects as strychnine. Strychnine is a white crystalline substance, very sparingly soluble in aqueous liquids, to which, however, it communicates an intolerably bitter taste. It is more freely soluble in acid and alcoholic liquids. When mixed with flour and sugar, and coloured by admixture with either soot or Prussian blue, strychnine forms the basis of several well-known forms of 'vermin-killer.' Spite of its repulsively bitter taste, strychnine has been administered with homicidal intent in such liquids as infusions of tea and cocoa, and in other media.

ANATOMICAL CHARACTERS. — The anatomical characters after death by strychnine-poisoning are very ill-marked, and at most consist of some congestion of the vessels of the spinal cord; and even this may be wanting.

SYMPTOMS.—Except when taken in the form of pill, strychnine and all substances containing it produce an immediate and intensely bitter taste, which is also at the same time of a quasi-metallic character, and is very persistent. Since the fatal dose—half a grain of the alkaloid—is small, and the poison is readily soluble in the acid gastric fluid, its physiological effects are, as a rule, not long delayed. They may be unmistakable after the lapse of two minutes; but commonly they are not well-marked till five, ten, or even twenty minutes after administration. They begin with a stage of restlessness, excitement, and a vague sense of impending peril. The special senses, too, are often preternaturally sharpened. A feeling of choking or impending suffocation ensues; then there is a trembling of the whole body; jerkings of the head; and, often in a moment, the whole body becomes stiff and rigid, assuming a bow-like form (opisthotonos), that is, arched forwards and resting perhaps on the head and heels only. The muscles even of the chest and abdomen are tense and fixed, so that respiration is impeded, giving rise to more or less cyanosis. The feet are either incurvated or excurvated. The angles of the mouth are drawn down, so as to give rise to the well-known *risus sardonicus* of tetanus. Attempts to administer medicine by either cup or spoon have been known to result in the patients biting the cup or spoon in two, in consequence of a violent spasmodic closing of the jaws. During the paroxysm, and indeed throughout the intoxication, the cerebral faculties are unimpaired, and the convulsions are purely of spinal origin. The pupils are dilated. In a few minutes, and often in half a minute, the muscular tension relaxes, and there is a complete remission of the spasms. The patient lies exhausted, and bathed in perspiration; the rapid pulse of excitement falls in frequency; respiration becomes more normal; and the dusky lividity of the countenance passes off. This remission is, however, of no long duration. A gentle touch, a footstep, even a breath of air impinging on the patient, results in a new crisis; and often with a wild, despairing cry, a renewed convulsion, similar to but more intense than the preceding one, is ushered in. The patient rarely dies during the first or second paroxysm, but the alternation of convulsions and quiet is repeated again and again till death ensues, usually in half an hour or an hour; or in non-fatal cases the fits become less and less frequent, less intense, and eventually cease. Death takes place commonly during a paroxysm, from asphyxia; but it may also occur in the intervals between the paroxysms, from exhaustion.

DIAGNOSIS.—The characteristics of strychnine-convulsions are so well-marked, as already described, that there is little likelihood of the nature of the case being overlooked; and the only disease with which strychnine-poisoning can readily be confounded is tetanus—traumatic, idiopathic, or hysterical. In the hysterical form of the disease, as described by some writers, the well-marked hysterical symptoms, the closed or half-closed eyes, the desire to be fanned, and the incomplete remissions of spasm, serve for diagnosis. Except in the history, there is nothing to distinguish between the traumatic and idiopathic forms of the disease, so that what is here stated with regard to the diagnosis between strychnine tetanus and traumatic tetanus, applies also to the idiopathic form. In traumatic tetanus the muscular symptoms begin with pain and stiffness of the neck and jaws, gradually passing into spasms; and the jaw is one of the earliest parts affected. The strychnine-symptoms, on the other hand, develop rapidly, and begin in the extremities, or a general convulsion at once seizes the whole body. Moreover, the jaw is usually last affected, and its muscles relax first. The strychnine relaxation is complete, or 'rarely' almost complete; whilst in traumatic tetanus there is permanent muscular rigidity, and no complete remission of spasm. Strychnine tetanus is an affair of minutes, or at most of half a dozen hours; whilst traumatic tetanus never kills within twelve hours, and generally extends over a few days. In strychnine-poisoning the most trivial movement or touch will set up a convulsion; whilst during the spasms firm grasping of the hands, and hard rubbing of the rigid muscles, will often afford grateful relief. This distinction is not marked in traumatic tetanus. An analysis of the urine by Stass's method, which often affords certain indications of strychnine, and may be made in a few minutes, will, in doubtful cases, at once remove all uncertainty as to the nature of the disease.

Prognosis.—The prognosis is at all times doubtful. The patient's life cannot be considered safe till the convulsions clearly exhibit marked decrease, both in frequency and intensity.

Treatment.—Should the convulsions have already set in, the use of the stomach-pump is out of the question. An emetic of warm water with mustard, or carbonate of ammonium, should be given without a moment's delay. The patient should be touched as little as possible, and absolute quiet observed in the sick-room. Excellent results have ensued from the administration of large doses of bromide of potassium; even half an ounce in one dose has been given. The salt serves the double function of rendering the poison insoluble, and counteracting its physiological effects. The gastric irritation produced by such large doses of the bromide as are necessary, militates against its use. Hydrate of chloral in full doses, and the anæsthetic administration of chloroform-vapour, are the best remedies. The free use of chloroform not only alleviates the pain and allays the spasms, but allows time for the elimination of the poison from the system. Nitrite of amyl has been recommended by Dr. Barnes. Strychnine-poisoning more often ends fatally either from the lateness with which remedies are applied, or their non-application, than from their inefficient character.

Thomas Stevenson.

STUPE (*stupa*, tow).—A synonym for a fomentation. *See* Fomentation.

STUPOR (Lat.)—Synon.: Fr. *Stupeur*; Ger. *Stupor*; *Stumpfsinn.*—A partial loss of consciousness. *See* Consciousness, Disorders of.

STUTTERING.—*See* Stammering.

STY (Sax. *steigan*, to rise up).—Synon.: *Hordeolum*; Fr. *Compère-Loriot*; *Orgelet*; Ger. *Gerstenkorn.*

Definition.—A boil on the margin of the eyelid.

Description.—A sty does not differ in any essential respect from a boil in any other situation, but it is usually of small size, and commences in the follicle of an eyelash. Sties are most common in young people, especially in anæmic girls, and are often very troublesome by frequent recurrence, in which case they may create a certain amount of permanent disfigurement by destroying hair-bulbs, and producing bald gaps in the margins of the eyelids. They are mostly associated with some obvious derangement of the general health, which should be made the subject of treatment.

Treatment.—An individual sty, if seen sufficiently early, when it is as yet only a small pimple, may often be rendered abortive by pulling out the eyelash which passes through it, and touching the spot with a fine point of nitrate of silver. When the time for this method has passed away, there is nothing to be done locally beyond the application of a fomentation or poultice, and a touch with a sharp lancet as soon as pus can be seen. Pain is at once relieved by the incision, and the swelling speedily subsides.

R. Brudenell Carter.

STYPTICS (στύφω, I constringe).—Definition.—In former years this term was held to include internal astringents, like the famous Ruspini's styptic, of which gallic acid was the principal ingredient; but we now limit its use to agents locally used to arrest hæmorrhage.

Enumeration. — The chief styptics are Cold, the Actual Cautery, Perchloride of Iron, Tannic Acid, Matico, strong Acids, Alum, Acetate of Lead, Nitrate of Silver, and Collodion.

Actions and Uses.—One class of styptics encourages the coagulation of the blood, by supplying a rough material around which fibrin may be deposited, in obedience to a well-known physiological law; the principal of these being matico, tannic acid, and the old-fashioned use of the cobweb. Others, in addition to their primary action in favouring the formation of a clot, coagulate the albumen of the tissues, or, like acetate of lead, and nitrate of silver, cause the bleeding mouths of the smaller vessels to contract.

The use of styptics is usually limited to the general oozing which is observed occasionally to follow the application of leeches, or the infliction of small wounds by accident or for surgical purposes, and may render essential service under a great variety of circumstances. If ice, pressure, rest, or posture fail to check such bleeding, we may have recourse to some of the more potent applications, particularly the caustic point or collodion.

R. Farquharson.

SUBACUTE. — A term applied to a disease when it has characters intermediate between acute and chronic, whether in *course* or in *intensity*. *See* Acute; Chronic; and Disease, Duration of.

SUBCUTANEOUS INJECTION. *See* Hypodermic Medication.

SUBCUTANEOUS NODULES. — *See* Rheumatism, Acute.

SUBSTITUTION.—This word is used in pathology in connexion with degeneration, when a newly formed tissue, inferior to the original in organisation or functional activity, takes the place of the normal structure. *See* DEGENERATION.

SUBSULTUS TENDINUM (Lat.)—A twitching movement of the tendons, caused by sudden momentary contractions of the muscles to which they belong. This is especially apt to show itself in the tendons about the wrist in the later stages of many low fevers. It manifests itself principally in states of great prostration, and is often associated with delirium or other signs of cerebral irritation. *See* TYPHUS FEVER.

SUCCUSSION (*succussio*, a shaking).—A method of physical examination, which consists in suddenly shaking the trunk of the patient, so that certain sensations or sounds may be elicited, which are indicative of the presence of gas and fluid in a hollow space, such as the pleural cavity. *See* PHYSICAL EXAMINATION.

SUDAMINA.—*See* MILIARIA; and SUDORIPAROUS GLANDS, Diseases of.

SUDORIFICS (*sudor*, sweat; and *facio*, I make).—A synonym for diaphoretics. *See* DIAPHORETICS.

SUDORIPAROUS GLANDS, Diseases of.—SYNON.: Fr. *Maladies des Glandes Sudoripares*; Ger. *Krankheiten der Schweissdrüsen.*

The morbid conditions of the sweat-glands will be noticed in the following order: (1) Inflammation; (2) Hyperidrosis, including (2*a*) Dysidrosis; (3) Bromidrosis; (4) Chromidrosis; (5) Hæmatidrosis; and (6) Anidrosis.

1. Inflammation.—Under certain conditions the sweat-glands may inflame; this generally happens to isolated glands, and often occurs as a sequel to the effects of mechanical irritation, such as scratching. An inflamed sweat-gland appears as a deep-seated movable nodule, which gradually involves the superficial structures, and ultimately suppurates from below. Inflamed sweat-glands, leading to the formation of small abscesses, are most likely to occur in regions where the glands are large, such as the anus, axilla, labia, and scrotum.

The *treatment* is by incision and appropriate dressings.

2. **Hyperidrosis.**—SYNON.: Ephidrosis; Idrosis.

DEFINITION.—Profuse sweating.

ÆTIOLOGY.—The cause of hyperidrosis, though certainly connected with the vasomotor nerves, is still obscure. It occurs in lesions of the brain and spinal cord, and especially in cases of compression of the sympathetic—as by tumours of the neck, or aneurysms, also as a result of traumatic injury involving the sympathetic, such as gun-shot wounds. The profuse sweating of phthisis and allied diseases probably depends likewise on paralysis of the sympathetic.

DESCRIPTION.—Hyperidrosis may be *general* or *local.*

When *general*, it may occur as an idiosyncrasy; more often it is due to the cachexia of disease, or accompanies acute febrile states. The skin is bathed in sweat, either spontaneously or as the result of slight effort. The nervous excitement and the continued loss of water tend to exhaust the already debilitated patient.

Obstruction to the free flow of the secretion by occlusion of the orifice of the duct may lead to effusion beneath the horny layer, and the formation of closely set, millet-sized vesicles, generally on the neck, chest, or abdomen. These are known as *miliaria crystallina* (sudamina), or, if the contents of the vesicles become clouded or yellowish-white, as *miliaria alba.* Should this retention be followed by inflammation, the regions affected become crowded with discrete vesicles or pustules seated on inflamed bases; the general redness of the skin has suggested the term *miliaria rubra.* The severe sweating which occurs in tropical climates may cause inflammation of the sweat-glands, and so give rise to a secondary obstruction of the secretion. A sudden eruption occurs of minute, acuminate, red papules (*miliaria papulosa*, *lichen tropicus*, or *prickly heat*), with which are mingled vesicles and pustules; these chiefly affect covered regions, and are accompanied by intense pricking or tingling.

Hyperidrosis may occur *locally* in the axillæ, genital regions, palms, or soles. The irritation and decomposition of the sweat may set up intertrigo or eczema of the groins; or, if the feet are affected, may give rise to a sodden, tender condition of the feet, which may impede walking. Sudoral eruptions in infants (*strophulus* or *red-gum*) may simulate the exanthemata, or co-exist with them.

2*a*. **Dysidrosis.**—It is convenient here to mention a disease which was first described by the late Dr. Tilbury Fox under the name 'dysidrosis.' According to Dr. Fox's description, profuse sweating, when occurring on the palms, is often associated with the eruption on the palms and interdigital surfaces of vesicles not formed in the usual way in the rete, but due to distension of the sweat-apparatus by sweat secreted in excess, and which fails to find its way outward upon the free surface. These sweat-vesicles are at first situated beneath the level of the skin, and indeed appear as little boiled sago-grains embedded deeply in the substance of the skin; and, when once seen, are easily recognised again. If they be pricked, a little sweat oozes out. These vesicles are distinct the one from the other at first, and are scattered about the interdigital surfaces or the palms;

or they may be grouped. In some cases their fluid contents dry away, or they enlarge and become prominent upon the surface, or run together into bullæ; and if the sweat secretion is free, large bullæ may form. Usually the cuticle becomes white and opaque from maceration in the fluid which collects beneath it; subsequently it peels off in a membranous manner, leaving behind a dry, reddened surface, but not a discharging one as in eczema. One or both hands or the feet may be attacked. The disease occurs in connexion with nervous debility. It may be attended with much itching or burning pain.

Diagnosis.—The vesicular forms of miliaria can hardly be mistaken for eczema. The sudden outbreak, the even distribution, and tendency to rapid spontaneous involution, are distinguishing characters. In prickly heat the eruption is more like that of eczema; but the sudden onset, the association with sweating and exposure to rapid changes of temperature, together with the peculiar pricking sensation and minute size of the papules, serve to distinguish it. The limitation of the disease to the hands or feet, its tendency to spontaneous recovery (the vesicles drying up, not continuing to exude as in eczema), and its occurrence during hot weather, are characters which serve to distinguish dysidrosis especially from eczema, with which it may be confounded.

Treatment.—The vesicular forms of miliaria and dysidrosis scarcely call for treatment, beyond the administration of saline diuretics, and the application of some protective desiccating powder. Prickly heat may give rise to more trouble. In addition to the above measures, purgatives should be given, and care taken to avoid sudden changes of temperature. Thin woollen underclothing should be recommended; with rest and simple diet. Locally, antipruritic lotions, such as two fluid drachms of Wright's liquor carbonis detergens to eight fluid ounces of diluted solution of subacetate of lead, may be used whenever the irritation prompts the patient to scratch. In other forms of hyperidrosis the general condition may demand tonic treatment by the mineral acids, nux vomica and iron. More specially directed to the disordered function are tincture of belladonna pushed to dryness of the throat; sulphate of atropine gr. $\frac{1}{150}$–$\frac{1}{60}$, injected hypodermically; liquid extract of ergot in doses of half a drachm three times daily; and sulphur, thirty grains twice daily, alone if it can be borne, or combined with aromatic powder of chalk if found to purge too freely. Locally, belladonna ointment or liniment rubbed into the affected part answers well. For hyperidrosis of the feet, strapping with stout lead plaister is recommended. Another plan is to thoroughly dust the boots and stockings every day with powdered boric acid—at the same time introducing into the boots cork socks, which are to be treated with a saturated solution of boric acid daily. This is probably the best method of treating this form of hyperidrosis of the feet. Other suitable local applications that may be mentioned are salicylic acid, quinine, alum, tannic acid, and disinfecting soaps.

3. **Bromidrosis.**—Synon.: Osmidrosis.

Definition.—Offensive sweating, from disorder of the sweat-glands or decomposition of the sweat after excretion.

Symptoms.—Bromidrosis may accompany, and be characteristic of, such diseases as rheumatic fever, syphilis, or uræmia; or it may be idiopathic. It may be general or local, the form which is most commonly met with being bromidrosis of the feet; but it may affect the axillæ and groins.

When the feet are affected, the odour is particularly offensive, and sometimes unfits the subject of the malady for society. It is generally associated with the sodden condition alluded to under hyperidrosis. The sweat is said to alter in character after excretion under the influence of a bacterium.

Treatment.—The method detailed under hyperidrosis—namely, that by treating the socks &c. with boric acid—will be found the most efficacious. Sulphur should be given internally.

4. **Chromidrosis.**—Synon.: *Seborrhœa Nigricans.*

Definition.—Coloured sweating or excretion of sebum.

Symptoms.—Symmetrical parts of the body, but chiefly the face, become covered with coloured sweat or sebaceous secretion, forming a powdery or granular deposit on the skin. The colour is usually black or sepia, but blue, red, green, yellow, and violet have been seen. It is supposed that colourless indican is secreted in the sweat, and oxidised on exposure to the air. The condition is generally accompanied by obstinate constipation.

Green sweat has been observed in individuals who work in copper or iron, the metal having become absorbed into the patient's system. Red sweat sometimes occurs in the axillæ from decomposition after excretion by micrococci. True chromidrosis is a rare affection, but a considerable number of well-authenticated cases have been recorded.

5. **Hæmatidrosis.** — Synon.: Bloody Sweat; *Ephidrosis Cruenta.*—This is a condition in which blood is found mixed with the sweat on the unbroken surface of the skin. The few cases observed have occurred in highly hysterical females, including Louise Rateau, under the influence of violent emotion. In some cases hæmatidrosis has been referred to vicarious menstruation (*menidrosis*).

6. **Anidrosis.**— Definition.—Deficiency of sweat.

All grades of this condition exist, from slight diminution to total absence. When universal, the condition may be symptomatic, as in diabetes mellitus, albuminuria, and fevers, or the absence of the function may be congenital, and due to malformation of the skin, as in xeroderma and ichthyosis. It may be temporary, accompanying the early stage of fevers; or part of a general malnutrition.

On patches of skin affected by leprosy, scleroderma, psoriasis, or eczema, the sweating function is in abeyance. Local idiopathic anidrosis is rare.

TREATMENT.—When the condition is acquired, tonic treatment is of service, combined with warm and vapour baths and shampooing. ALFRED SANGSTER.

SUFFOCATION (*suffoco*, I stifle).—SYNON.: Fr. *Suffocation*; Ger. *Ersticknung*.

DEFINITION. — The term 'suffocation' is sometimes employed synonymously with asphyxia. In the strict medico-legal sense it signifies asphyxia induced by obstruction of the respiration otherwise than by direct pressure on the neck (hanging, strangulation), or submersion (drowning).

ÆTIOLOGY.—Death by suffocation is usually the result either of accident or of homicide, rarely of suicide.

Suicide by suffocation is indeed not unknown. Cases of suicide by immurement in a box or trunk, or by thrusting a pad or other obstruction down the throat, have been reported; and it has been averred that slaves, both in ancient and modern times, have committed suicide by rolling the tongue back into the pharynx.

Accidental suffocation is very common by diseases causing occlusion of the air-passages; by the impaction of pieces of food or other obstacles in the pharynx; by the entry of foreign bodies into the larynx, as a seed, coin, or food, in cases of bulbar or general paralysis, or matters vomited in a state of insensibility; by mechanical pressure on the chest and abdomen, as in crowds, or in falls of earth or heavy bodies; by various diseases preventing the expansion of the lungs; by diseases of the lungs themselves; or by obstruction of the pulmonary circulation. Suffocation of new-born children by smothering under bed-clothes, non-removal of maternal envelopes, or overlaying, may happen from carelessness as well as from intent. *See* OVERLAYING.

Homicidal suffocation is resorted to chiefly in infants, or in the case of persons feeble and infirm, or rendered powerless or insensible by intoxication or narcotics. Closure of the mouth and nostrils by the hands, or obstruction of the mouth and nostrils by a pillow, mattress, or the like, perhaps combined with pressure on the chest, is the method usually adopted. Formerly suffocation by mechanical pressure on the chest was a judicial punishment—the *peine forte et dure*.

SYMPTOMS AND SIGNS.—The mode of death, and the general *post-mortem* indications, are those of asphyxia (*see* ASPHYXIA). The special indications of suffocation, and the way in which it has been brought about, may be evident from the place where the body is found, and its surroundings; or foreign bodies, or disease obstructing the air-passages or respiratory mechanism, may be clearly evident on *post-mortem* dissection; or there may be marks of violence and indications of pressure on the chest, flattening of the nose, &c., pointing to homicidal violence. The absence of marks of constriction of the neck excludes strangulation and hanging.

But in the absence of all such indications as have been enumerated above—and they may all be absent, especially in cases of infanticide — the question is whether any trustworthy conclusion can be formed as to asphyxia by suffocation.

The condition of the lungs is of especial importance in this relation. The lungs may be congested, or pale, or congested only posteriorly; but the surface is often uneven, owing to an emphysematous condition of some of the superficial air-cells; and in particular the lung looks as if it had been sprinkled with minute drops of a dark purple fluid. These spots, not much larger than a pin's head, are known as 'Tardieu's spots,' and are due to minute capillary extravasations under the pleura. They are not, however, confined to the surface of the lungs, but are found also in considerable numbers on the thymus gland, the base of the great vessels, under the parietal pleura, and also under the pericranium. Tardieu, who first called special attention to these spots, considered them absolutely diagnostic of death by suffocation, as distinguished from other modes of asphyxia. But numerous other observations have shown that this cannot be accepted as correct, inasmuch as similar extravasations have been found in cases of hanging, strangulation, drowning, and deaths from cerebral injuries. It seems, however, fairly well established that they occur most frequently, and in largest number, in suffocation, especially in infants. Their formation depends on excessive vascular tension during the asphyxiating process. Similar spots have been found in the lungs of still-born fœtuses, conditioned by obstruction of the placental circulation; and in the lungs of new-born children, perishing from other causes, extravasations of a like nature have been observed. It would, therefore, be unsafe to rely absolutely on Tardieu's spots as indications of suffocation, though, in the absence of other causes of death, and in presence of these spots in large numbers and in clusters, the opinion of death by suffocation would be fairly justified.

TREATMENT.—The treatment of impending suffocation is that of asphyxia. *See* ARTIFICIAL RESPIRATION; ASPHYXIA; and RESUSCITATION. D. FERRIER.

SUFFOCATIVE BREAST-PANG. A synonym for angina pectoris. *See* ANGINA PECTORIS.

SUFFOCATIVE CATARRH. — A condition in which the bronchia are filled with abundant secretion; chiefly met with in capillary bronchitis and œdema of the lungs. *See* BRONCHI, Diseases of; and LUNGS, Inflammation of.

SUFFUSION (*suffundo*, I pour down). The process or the result of the unnatural pouring out of a fluid into the tissues; closely analogous to effusion and extravasation. *See* EXTRAVASATION.

SUGGILLATION (*suggillo*, I make black by beating).—The appearance produced by extravasation or ecchymosis of blood. The term is limited by some writers to the appearance of livid spots on the body after death.

SUICIDAL INSANITY. — *See* INSANITY, Varieties of: Impulsive Insanity; and MELANCHOLIA.

SULPHONALISM.—DEFINITION.— A group of symptoms said to be occasioned by the prolonged administration of sulphonal.

Sulphonal is now extensively employed, and is one of the favourite hypnotics in institutions for the insane. Being tasteless and odourless, fairly soluble in such vehicles as hot soups, not productive of digestive derangements, and obtainable without medical prescription, it has become very generally known to the laity; and thus a 'sulphonal-habit' has been met with which demands recognition and treatment.

SYMPTOMS. — The prominent symptoms noted in the recorded cases of poisoning by sulphonal are vomiting, abdominal discomfort, gastro-intestinal disturbance, cephalalgia, tinnitus aurium, drowsiness, incoördination, diminution of reflex excitability, puffiness of the eyelids, ptosis, and more or less mental and physical weakness. The urine, which decomposes slowly, becomes of a port-wine or Burgundy-red colour, possibly with coincident evidences of renal inflammation. This peculiar colour of the renal excretion, which is said to be due to the presence of non-ferrous hæmatin or hæmatoporphyrin (*see* SPECTROSCOPE IN MEDICINE), resulting from extensive disorganisation of hæmoglobin, is thus of clinical significance, serving as a means of recognising the abuse of the drug, and to be regarded as an index for its immediate temporary discontinuance. Of rarer occurrence is a papular, measly, erythematous, or scarlatiniform eruption. Possibly many of the phenomena noted in the recorded cases were symptoms of the disease from which the patient was suffering, and ought not to have been accredited to the drug.

TREATMENT.—The treatment of sulphonalism consists in suspending the administration of the sulphonal until all unfavourable symptoms have disappeared; and by the use of diuretics, promoting the elimination of the drug, at least in cases where it has been taken in large doses. If it should have to be taken regularly for a lengthened period, the use of it should be occasionally intermitted for a few days, another suitable hypnotic being substituted temporarily.

JOHN HAROLD.

SULPHUR WATERS.—*See* MINERAL WATERS.

SUNBURN.—DEFINITION.—Under this designation are included the superficial local effects of exposure to the sun's rays.

Such effects vary greatly with the susceptibility of the individual, the surrounding circumstances and conditions, and the duration or repetition of the exposure. They may be comparatively slight and transient, as is commonly the case; or they may be very severe, and involve considerable and prolonged suffering, and sometimes serious constitutional disturbance.

ÆTIOLOGY.—Delicate, thin-skinned, fair-complexioned subjects are most liable to suffer from sunburn; the thick-skinned and swarthy much less so. The rays reflected from snow or ice (especially through rarefied atmosphere), as experienced by Alpine climbers, or from water surface, sea or river, are most hurtful. Exposure to the rays from powerful electric arc lights may be followed by effects more or less similar to those resulting from exposure to the solar rays (Tyndall, Hewetson).

There is evidence to suggest, if not to prove, that sunburn is due not to the heat rays alone, but further to other influences, especially to those of the violet and ultra-violet rays (Bowles).

SIGNS AND SYMPTOMS.—First, in the slight, familiar cases, there is redness of the skin from vascular congestion (*erythema solare*), accompanied by tingling and sense of heat. This is followed by desquamation and subsequent pigmentation, either uniformly diffused ('tanning') or especially localised in spots, giving rise to freckles (*ephelis*). All these more or less speedily subside, and are the only points to be noted. Pigmentation may occur without previous noticeable erythema, as is evidenced by the 'browning' of patients who have wintered at Davos or other Alpine resorts, or who have been otherwise exposed to snow-reflected sun rays.

Secondly, in the more severe cases, the erythema is followed by vesication, and more or less deeply extending inflammation of the skin. An erysipelatoid condition may ensue, with œdema and considerable swelling of the part, severe pain, and great tenderness. This may be accompanied by constitutional disturbance.

Thirdly, in the worst cases, happily very rare, sloughing and ulceration to greater or less extent occurs. *See* HEAT, EFFECTS OF SEVERE AND EXTREME.

TREATMENT.—In the slighter cases of sunburn little or no treatment is required. Simple powdering with starch, oxide of zinc, bismuth or boric acid, or dabbling with elderflower or rose water, with a little eau-de-Cologne or solution of acetate of ammonium, may be pleasant. The more severe cases must be treated on general principles. Lead lotion with morphine or cocaine will relieve the heat and pain. The solution of subacetate of lead with glycerine and elder-flower or rose water is also a good application.

It is, however, almost more important to prevent than to cure. The preventive treatment obviously consists in protecting exposed parts from the deleterious effects of the sun's rays. When sunshades, veils, and masks are inconvenient—especially in cases of Alpine climbers and others—Dr. Bowles [1] recommends, with good reason, founded on extensive experience, that the face, arms, and other exposed parts should be painted over with the 'grease paints' used by actors for 'making up.' Brown is the best colour, but pink will serve. Pigments mixed with glycerine of starch would probably be better than those mixed with 'grease.' For sunshades, veils, and similar protections, brown or some shade of yellow is the best colour. The 'tanning' of the skin, which naturally takes place, is the best protective against suffering from subsequent exposure.

In those who have been year by year subject to 'sunburn,' the skin becomes dry and wrinkled, from the effect upon the sudoriparous and sebaceous follicles—as well as browned by pigmentation. Such result may be to some extent prevented by the ancient practice of oiling the skin.

For the freckling and browning of the skin after sunburn, lotions of perchloride of mercury or boric acid, with emulsion of almonds, and glycerine, or juice of cucumber, are extensively used with more or less beneficial effect. ARTHUR E. DURHAM.

SUNSTROKE. — SYNON.: Insolation; Heat-stroke; Fr. *Coup de Soleil*; Ger. *Sonnenstich.*

DEFINITION.—Certain pathological conditions resulting from exposure to solar or artificial heat.

Three well-marked varieties of sunstroke are recognised, namely: (1) Exhaustion and failure of the heart's action in *syncope*; (2) A condition like shock, in which the nerve-centres, and especially the *respiratory*, are affected, causing rapid failure of the respiration and circulation; and (3) Intense *pyrexia*, due to vaso-motor paralysis, and to the nerve-centres being over-stimulated and then exhausted by the action of heat on the body generally.

ÆTIOLOGY AND PATHOLOGY.—These morbid conditions, being due to heat alone, are not peculiar to any country or climate, and are liable to occur wherever persons are exposed under any circumstances to great heat, whether solar or artificial. Soldiers marching or fighting, when oppressed by weight of clothing and accoutrements, are apt to suffer either from simple heat-exhaustion, or that form of insolation which results from direct action of the sun on the head and neck. This is common enough in India during the hot season, in other tropical countries, and in America; and is not unknown in Europe or even in England during the heat of summer. Workmen, artificers, stokers, and other persons in heated rooms, hospitals, barracks, tents, and even ships, especially in hot climates, are liable to suffer from heat-exhaustion, which may pass into the dangerous condition of fever or insolatio.

But the most frequent cases are those which occur in houses, barracks, tents, ships, by night or in the day, away from the direct solar rays. A form of disease sometimes described as 'ardent fever' in India, is this condition supervening on the ordinary phenomena of ephemeral fever. It seems pretty well understood that heat alone is the effective cause of the so-called sunstroke. Malarial and certain hygrometric or barometric states of the atmosphere have no special influence, beyond that which they may exert on the general vigour of the constitution, or in rendering a person more or less susceptible to heat, and so far predisposing him to suffer from it.

A dry air, such as that of North India, with hot winds, is much better tolerated at a high temperature, than the damp atmosphere of Bengal at a much lower one; for the dry hot air favours evaporation, and thus keeps the body cool, whilst in the damp, heavy atmosphere the natural cooling function is almost in abeyance. Vigorous, healthy persons of moderately spare frame, possessing sound viscera, and leading temperate and regular lives, can tolerate a great amount of heat, in an otherwise pure atmosphere, and are much less liable to suffer from it than those in whom these conditions do not exist. Acclimatisation has also considerable influence in conferring toleration. New arrivals are more prone to suffer than those who have become accustomed to the climate. It is well known that the native can bear an amount of sun on his shorn head, neck, and half-naked body with indifference, if not pleasure, that would very soon prostrate a European. But to a temperature of the air rising above a certain standard, all succumb; and the natives of India suffer like others, and die in numbers every year from *loomarna* or 'hot-wind stroke.'

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[1] *Journal of Dermatology*, vol. v.

The exact amount and duration of toleration of a high temperature depend to a great extent, therefore, on the vigour of constitution and the present state of health. The natural refrigerating powers of the body, when in health, are such as to enable men to support very high temperatures, much above that of the normal state of the body. Thus in the hot dry winds no inconvenience beyond discomfort is felt, so long as transpiration and perspiration are free, which cool down the body, enabling it to resist the great heat. It is obvious that in this there is a great expenditure of force, and when it fails suffering soon ensues. Disordered health, dissipation, over-fatigue, anything in fact that depresses nerve-power, reduces the normal physiological capacity, and consequently renders a man more liable to succumb.

ANATOMICAL CHARACTERS.—In cases where death has taken place suddenly, as from *shock*, there is no very remarkable *post-mortem* appearance. The heart may be found firmly contracted, but not always so—it may be flaccid. The lungs and the brain and its membranes may be somewhat congested, but not invariably. As in cases of shock, the venous trunks, specially those of the abdomen and the right side of the heart, may be too full of blood, and the pulmonary vessels overloaded; but the lungs in some cases are blanched from absence of blood, owing to contraction of the pulmonary arterioles. The blood itself is dark and grumous, and is found effused in patches of ecchymoses, indeed rendering the body more or less livid; the coagulability of the blood is also impaired, and it is wanting in oxygen.

In death from ordinary cases of *thermic fever*, the lungs and respiratory organs are often deeply congested; the heart is firmly contracted from coagulation of myosin; the whole venous system is engorged; and the body even before death is marked by petechial patches, or extensive ecchymoses of a livid appearance. The blood is generally more fluid and grumous than natural; its coagulability is impaired; and it is acid in reaction. The red corpuscles, though generally presenting no abnormal change, are somewhat crenated, and have less tendency to form rouleaux than in health; and the quantity of oxygen is much diminished. The body for some time after death retains a high temperature; when first opened, the viscera feel pungently hot, and the incisions drip dark blood. *Rigor mortis* comes on very rapidly, from early coagulation of myosin.

The brain and membranes may be found congested, and in some cases there may be evidence of meningitis. Serous effusions into the ventricles, or hæmorrhage into the brain-substance, may have occurred, and are not improbable in the congested condition sometimes existing in the head; but the cause of death is asphyxia, not apoplexy, and the most important changes are found in connexion with the thoracic viscera.

SYMPTOMS.—(1) **Syncopal form.**—SYNON.: Heat-exhaustion.—Simple exhaustion and syncope may occur under great fatigue or over-exertion, or depression from any cause, during exposure to a high temperature. There is depression of nerve-force, and prostration of muscular power; the skin is pale, cold, and moist; and the pulse is quick and feeble. Death may occur rapidly in the state of collapse from failure of the heart. Complete recovery is frequent.

(2) **Asphyxial form.**—SYNON.: Sunstroke proper.—Asphyxia and apnœa may come on very rapidly, after certain premonitory symptoms of depression and weakness, though occasionally without prodromata, during exposure, especially of the head and spine, to the direct rays of a powerful sun, when the atmosphere is much heated, and the nervous energy has been depressed by over-fatigue, dissipation, or illness. The brain and nerve-centres, especially the respiratory, are overwhelmed by the sudden elevation of temperature, and respiration and circulation fail, the failure of the latter being probably due to the inhibitory influence of the vagus. When death takes place, as it does sometimes very suddenly, during great excitement or exertion, it has been attributed to rapid *ante-mortem* coagulation of the cardiac myosin. This, however, though it may occur occasionally, is generally a *post-mortem* change, the heart's action being brought to a close by the heat; in the same manner as it has been shown by Claude Bernard and Lauder Brunton that the effect of high temperature on animals is first to accelerate and finally to stop the heart, and especially the ventricles, in a state of contraction. Recovery is frequently complete, but sometimes tedious, and in many cases imperfect, ending in serious impairment of health or intellect, indicative of structural changes caused in the nerve-centres. The symptoms of this form of insolation, the real *coup de soleil*, are those of sudden and violent injury to the nerve-centres—unconsciousness, cold skin, feeble pulse, and all the symptoms of depression; death resulting from rapid failure of the respiration and circulation. If not fatal, reaction may result in a variety of conditions indicative of the injury done to the cerebro-spinal system.

(3) **Hyperpyrexial form.** — SYNON.: Heat-fever.—An intense state of fever, the result of the influence of heat on the nerve-centres, and through them on the vaso-motor nerves, and of the heating of the body generally, by the direct action of either artificial or solar heat, may occur, quite independently of the immediate operation of the sun's rays. It comes on as frequently at night, or in the shade, as in the day or in the sunshine, especially in persons who are ex-

hausted by fatigue, overcrowding, depression from any cause, such as dissipation, want of rest, present or recent illness, and notably when the atmosphere is impure from overcrowding or want of cubic space.

The temperature of the body rises to 108°, 110° F., or higher. The brain, medulla, and cord, the nerve-centres generally, and especially the respiratory, suffer from overstimulation, followed by exhaustion. Respiration and circulation fail; there is dyspnœa, with hurried, gasping breathing; great restlessness; thirst; fever; frequent micturition; and a pungent burning heat of skin, which is sometimes dry, sometimes moist. The pulse varies; in some it is full and laboured, in others quick and jerking. The face, head, and neck are congested to lividity, and the carotid pulsations are visible. The pupils, contracted at first, may dilate widely before death. Delirium with convulsions, frequently epileptiform in character, coma, relaxation of the sphincters, and suppression of urine, come on, and are frequently the precursors of death. Recovery not infrequently partially occurs, to be followed by relapse and death; or secondary consequences result in meningitis or cerebral changes, which may destroy life or intellect at a later period, or permanently compromise the whole health or that of some important function.

The premonitory symptoms of this form of insolation often manifest themselves for some hours, and it may be days, before they culminate in the dangerous condition just described. These premonitory symptoms are general malaise; disordered alvine or other secretions; profuse and frequent micturition; restlessness; sleeplessness, and apprehension of impending evil; hurried and shallow breathing; præcordial anxiety; giddiness and headache; occasionally nausea or vomiting; thirst and anorexia; and feverishness, which soon amounts to a pungent heat of skin with high temperature. These symptoms vary considerably, but they point to a profoundly disturbed state of the cerebrospinal nerve-centres, and to pathological changes in the organs or structures whose functions have been so gravely disturbed. Recovery is often incomplete; or is followed by permanent impairment of health, and generally by intolerance of heat and exposure to the sun.

Terminations.—The mortality from sunstroke is about 45 to 50 per cent.; but of those who recover many are permanently injured, and remain invalids for the remainder of life, which is often shortened by the changes induced. There may be some weakness, due to obscure structural change in the cerebrum, or to a chronic form of meningitis which affects the sufferer in various degrees of intensity; or epilepsy, impairment of memory, great nervous irritability, headache, insanity, partial paraplegia, partial or complete blindness, and extreme intolerance of heat—especially of the sun's heat—rendering the person utterly incapable of serving or living in a hot climate, or of enduring exposure to the sun. Or the case may gradually end in complete fatuity, insanity, or meningitis, which accounts for the intense cephalic pain; or, in a lesser degree, in disordered innervation and derangement of the functions generally, thus seriously compromising the general health.

Treatment.—(1) In cases of *simple exhaustion* mild treatment is all that is needed. Removal to a cooler locality, the cold douche (but not too much prolonged), or the administration of stimulants may be beneficial. Tight or oppressive clothing should be removed, and the patient treated as in syncope from other causes. *See* Resuscitation.

Rest, and freedom from exposure to overexertion, fatigue, or great heat, should afterwards be enjoined.

(2) In that form of sunstroke where the person is *struck down* suddenly by a hot sun, the patient should be removed into the shade. Here a douche of cold water must be allowed to fall in a stream on the head and body, from a pump (or as in India from the mussuck, or other similar contrivance), the object being twofold—to reduce the temperature of the over-heated centres, and to rouse them into action. During the assault on the White House picquet in the second Burmese war, numbers of men were struck down by the direct action of the sun during the month of April. They were laid out perfectly unconscious, in their red coats and stocks (worn in 1852), but were recovered by the cold douche freely applied by the mussuck over the head and body. In some cases flagellation with a broom was added; and all recovered with the exception of two cases, both of which had been bled on the spot where they fell. Mustard plasters and purgative enemata may also be useful.

If recovery be imperfect, and followed by any indication of injury to the nerve-centres, or by the supervention of meningitis, other treatment may be necessary, according to the indications. Much exposure to the sun should be carefully guarded against; and unless recovery be complete and rapid, the sufferer should be removed to a cooler climate, the most perfect rest and tranquillity of mind and body enjoined, and the greatest care observed with regard to extreme moderation in the use of stimulants.

(3) In the cases of *thermic fever*, heat being the essential cause of the disease, the object is to reduce the temperature of the body as quickly as possible, and before tissue-changes have resulted. As the hyperpyrexia is due not only to the direct operation of heat, but to fever set up, remedies such as may influence this disturbed condition have been

suggested. The results have appeared in some cases to justify the theory, and the hypodermic injection of quinine has been considered to produce good results.

Bleeding has now happily been almost abandoned. The congested livid surface, coma, and stertor, which formerly suggested it, are not now so treated. There are cases in which it may still be practised with advantage; but they are the exception and not the rule. In cases where venesection has appeared first to give relief and mitigate the symptoms, the improvement has been often transient, and been followed by relapse into a more dangerous condition, which has terminated fatally. At the same time no absolute rule can be laid down in this disease with reference to the abstraction of blood; and it is quite possible that greater immediate danger to life may exist in an over-distended right heart than in the loss of an amount of blood which might have tided the patient over that state of peril. Each case must in this respect be treated on its merits. The treatment generally consists in the judicious use of cold, either by affusion or by the application of ice to the surface; the reduction of the temperature being watched with a thermometer in the axilla, mouth, or rectum.

Care should be taken not to continue the cold application too long, as danger arises from depressing the temperature below the normal standard. The bowels should be relieved; and quinine may be given internally or in the form of hypodermic injection.

In the epileptiform convulsions that occur so frequently, the inhalation of chloroform or of ether may be of benefit, but their administration must be carefully watched. The earliest and most severe symptoms having subsided, the febrile condition that follows is treated on ordinary principles—salines and aperients being given, but not to the extent of depressing the patient. The diet must be carefully regulated, and of the blandest and most nourishing nature.

As improvement progresses, other symptoms may supervene, indicative of intra-cranial mischief. Where they are indicative of meningitis, iodide of potassium and counter-irritants may be used with advantage. Removal to a cooler climate is essential. As a general rule, it is desirable that the sufferer should not, for a long period at least, return to a hot or tropical climate; and he should be guarded against all undue exposure to heat, work, or mental anxiety of any kind.

The sequelæ of sunstroke are frequently from such causes most distressing, rendering the patient a source of suffering to himself and of anxiety to his friends.

The less severe symptoms—those, probably, indicative of the slighter forms of meningitis, or of lesions of the brain or nervous system—occasionally pass away after protracted residence in a cool climate; but they not infrequently also cause much suffering, and shorten life. As they point to permanently disturbed, if not structurally injured, cerebro-spinal centres, the treatment required is as varied as the symptoms presented.

Joseph Fayrer.

SUPPOSITORY (*suppono*, I place below).—Synon.: Fr. *Suppositoire*; Ger. *Stuhlzäpfchen.*—A suppository is a solid mass, which is introduced through the anus into the rectum for certain therapeutic purposes. The material of which it is made should be capable either of being dissolved, or of melting at the temperature to which it is exposed in the rectum.

Suppositories may be divided into *simple*, *medicated*, and *nutrient*. Simple suppositories may be exemplified by pieces of soap or tallow-candle, which are in popular use as aperients. The British Pharmacopœia now recognises nine suppositories, one of which may be regarded as simple, the remainder being medicated. The latter are made up either with oil of theobroma, or with glycerine of starch and curd soap, to which starch is added in some instances. Each suppository is cast into a mould of a conical or other suitable shape, so as to facilitate its introduction into the bowel. It may be well to give a list of these official preparations, with the proportions of their active ingredients, as follows:—

S. Glycerini = 70 per cent. of Glycerine. S. Hydrargyri = Mercurial Ointment gr. 5. S. Plumbi Composita = Acetate of Lead gr. 3, Opium gr. 1. S. Acidi Carbolici cum Sapone = Carbolic Acid gr. 1. S. Iodoformi = Iodoform gr. 3. S. Acidi Tannici; S. Acidi Tannici cum Sapone = Tannic Acid gr. 3. S. Morphinæ; S. Morphinæ cum Sapone = Hydrochlorate of Morphine gr. ½.

Besides these official suppositories, others are often prepared and used, containing belladonna, cocaine, and other agents; and the practitioner may employ many drugs in this way with advantage, according to his own judgment.

Nutrient suppositories usually consist of lean meat that has been finely minced and peptonised.

Application.—A suppository must be introduced well into the rectum, beyond the sphincter ani. At first this should be done by the practitioner, or by a competent nurse; but subsequently many patients learn to use suppositories for themselves without any difficulty. The suppository should be oiled, and passed in gradually and gently with a screwing movement and without any undue force. It may be necessary to keep the finger applied for a moment over the anal aperture, until the tendency to expulsive action on the part of the rectum has subsided.

Uses.—A suppository may be used for the following purposes: (1) As a mere aperient, by exciting the expulsive action of the bowel through local irritation, which also has a reflex effect upon the intestine above. (2) On the other hand, to subdue excessive action of the bowel, and thus check diarrhœa. (3) To bring medicinal agents into contact with the rectum in a suitable form, in order to affect some local disease. Astringents and antiseptics are thus used. (4) To influence adjacent organs, the active ingredients of the suppository being absorbed. For instance, a morphine suppository will often produce a marked effect upon the bladder and generative organs. (5) To produce the general effects of a drug upon the system, particularly when it cannot be given by the mouth. This of course occurs only after its absorption through the mucous membrane, and may be exemplified by the effects of morphine or mercury. (6) To nourish patients when rectal feeding is called for.

Frederick T. Roberts.

SUPPRESSION.—The complete stoppage of a natural secretion or excretion, such as the urine; or of a normal discharge, as of the menses. The word is used in contradistinction to *retention*, which signifies that these fluids merely remain in the body unexpelled.

SUPPURATION.—The formation of pus. *See* Abscess; and Inflammation.

SUPRARENAL CAPSULES, Diseases of.—Synon.: Fr. *Maladies des Capsules Surrénales*; Ger. *Krankheiten der Nebennieren.*

Of the morbid conditions of the suprarenal bodies by far the most important is that connected with Addison's disease, which is described separately. *See* Addison's Disease.

Other morbid changes producing neither pigmentation nor asthenia, belong to two categories, namely (1) those beginning *within*, and (2) those originating *without*, the suprarenal bodies. Some of the latter may, however, give rise to the symptoms of true Addison's disease, as when the mischief seems to begin in caries of the spine, and ends in the characteristic suprarenal changes commonly associated with that malady. The bodies may be otherwise extensively diseased, and yet no special pigmentation and no special asthenia make their appearance. Thus there may be the usual *anomalies of development*, amounting even to what has been called total absence, but this probably depended on defective examination. Certainly the bodies may be *hypertrophied.* According to Stilling, if in animals one capsule be removed, the other one undergoes compensatory hypertrophy. Both the organs themselves and their coverings are liable to *inflammation*, especially if the structures connected with the kidney be likewise attacked, and the process spread from them. They may also be the seat of various forms of *degeneration.* Lardaceous degeneration occurs associated with similar degeneration of other organs; more or less fatty degeneration of the cells of the cortex is an almost constant change, as is also pigmentation of the inner layers of the cortex. With regard to *tubercle*, some authorities would have the anatomical change in Addison's disease to be of this nature. Miliary tubercles are sometimes found in cases of acute tuberculosis. *Cysts* sometimes occur, but the exact mode of their origin is not quite clear.

We are on surer ground when we speak of *hæmorrhage* and *malignant disease.* One case of what may fairly be described as *thrombosis* is reported by Klebs from Lücke's *clinique.* There can be no doubt about the not infrequent occurrence of hæmorrhage, however arising. Neither is there any question as to the existence of malignant disease. Cancer occurs both as a primary and secondary growth; the latter is the more frequent. Sarcomatous tumours have occasionally been met with, especially melanotic sarcoma. Adenomatous tumours also occur, formed of true gland-tissue, resembling that of the cortex. Syphilitic gummata have also been found, though very rarely. As a rule, all these changes give rise to no characteristic symptoms during life; and are either accidentally discovered after death, or by careful clinical search. The important point to bear in mind is that not one of them gives rise to the symptoms of Addison's disease.

Alexander Silver. W. Cayley.

SURGICAL KIDNEY.—Definition. This term, although open to many objections, may be conveniently employed to group together the various morbid conditions which arise in the kidney as the result of diseases of the lower urinary tract.

Pathology.—Diseases of the lower urinary tract react on the kidney in three ways: (*a*) by obstructing the passage of urine, and so causing abnormal tension throughout the whole urinary tract above the obstruction; (*b*) by causing repeated disturbances of the circulation in the kidney, through the medium of the nervous system; (*c*) by decomposition of the secretions spreading from without to the bladder, and extending to the pelvis and even into the tubules of the kidney, or by the invasion of the bladder by a pathogenic organism.

(*a*) Obstruction to the free passage of urine may occur in the ureters from congenital malformation; from impaction of a calculus; or from pressure of a tumour growing in the neighbourhood. It may occur at the vesical orifice of the ureter, from the thickening of the wall of the bladder in hypertrophy; from the thickening and induration of the submucous tissue, and the swelling of the mucous membrane in chronic cystitis; or from the growth of villous or cancerous tumours round the orifice. Obstruction of such a nature as to cause secondary renal affection also occurs in any disease in which the bladder is unable to empty itself, and is consequently in a permanent state of greater or less distension, as in hypertrophy of the prostate or atony of the bladder. Stricture of the urethra and stone in the bladder cause obstruction at the vesical orifices of the ureters, by the chronic cystitis to which they give rise. There is no reason to believe that the valvular orifices of the ureters ever become incompetent, so as to allow of regurgitation from the bladder to the pelvis of the kidney. The only force concerned in producing the remarkable degree of dilatation so often met with in the ureter and pelvis of the kidney is the force of secretion. The abnormal tension thus produced extends, therefore, equally from the point of obstruction to the closed extremities of the urinary tubules.

(*b*) Diseases or injuries causing irritation of the lower urinary tract, especially of the trigone of the bladder and the prostatic, membranous, and bulbous portions of the urethra, react on the kidney in a reflex manner, through the medium of the nervous system. The effect produced is a disturbance of the renal circulation, probably a temporary arterial contraction with anæmia, followed by dilatation with hyperæmia. Such disturbances tend to aggravate any inflammatory process which may be going on in the kidney as the result of other sources of irritation. If the kidney be already much diseased, the circulation may become completely arrested by choking of the vessels during the stage of hyperæmia, and total suppression of urine may result, terminating in some cases fatally. The evidence of this reflex disturbance of the renal circulation is derived from the following facts. (1) Many cases have been recorded of death from total suppression of urine occurring as a consequence of operations involving some mechanical irritation of the parts above mentioned. In such cases the kidney has always been found intensely congested. (2) It is a matter of common surgical experience that operations on the urinary organs frequently prove fatal by inducing acute inflammation of the kidneys. This is (as will be presently shown) often the result of the introduction of the micro-organisms into the bladder, followed by extension of decomposition to the kidney. But cases frequently occur in which the patient before the operation was suffering from cystitis, with putrid urine, and had been so suffering for some time; and in these it is evident that the final acute attack is the direct result of the irritation of the operative procedure (3) By direct observation of the urine passed after such an operation as forcible dilatation of a stricture, evidence of a disturbance of the renal circulation may be obtained. In the most typical cases there is temporary suppression of urine, probably corresponding to a period of anæmia of the kidney, with contracted vessels. This may last from one to three hours. It is followed by a gradual increase in the quantity of urine, which now frequently becomes uniformly tinged with blood, the amount of blood often increasing for some hours, and then slowly diminishing. This blood cannot be supposed to flow at so late a period from a lacerated wound, such as is produced by forcible dilatation; it is uniformly mixed with the urine and free from clots. The presumption is, therefore, that it comes from the kidney. In most cases the period of suppression is too short to be noted, and in others an immediate increase in the flow of urine has been observed. The rigor which frequently occurs within a few hours of an operation on the lower urinary tract is, in many cases, doubtless due to this disturbance of the renal circulation.

(*c*) The final fatal inflammation of the kidney is, in most cases, due to extension of decomposition of the urine from the bladder, or to infection of the urinary tract by a pathogenic organism. Decomposition of the urine is a process of fermentation due to the presence of an organised ferment—a micro-organism. Microscopic examination of foul urine always shows that micro-organisms of various kinds are present. The most constant of these is the *bacterium* or *micrococcus ureæ.* In the urine it commonly occurs as a micrococcus, singly or in chains. It frequently forms irregular masses embedded in a hyaline gelatinous matrix or zooglœa. In cultivations, it grows at first in the form of short rods, which subsequently break up into chains of cocci. This organism is supposed to be the special ferment causing ammoniacal fermentation of urine. It is not pathogenic, but the products it gives rise to in its growth are extremely irritating. Many other varieties of microscopic fungi are commonly found in decomposing urine. Short bacteria, showing active movements, are very common; bacilli containing spores may be met with, and more rarely spirilla. Owing to the mixture of these various organisms in the urine, their accurate study by cultivation is very difficult. There is no reason to believe that the majority have any pathogenic properties, the mischief they do being solely by means of the chemical products of their growth. On the other hand, it seems equally probable that these pathogenic organisms may invade the bladder, and spread thence by the lymphatics to the kidneys; or, by entering the blood-stream, may cause general infection. It is not uncommon, in fatal urinary cases, to find a patch of varying size in the bladder covered with a membrane closely resembling that of diphtheria. Microscopic examination shows that this membrane is composed of a coagulated exudation containing cells, apparently leucocytes, and multitudes of micrococci. The tissues of the bladder-wall beneath this membrane are infiltrated with leucocytes, and micrococci are abundantly present in the lymph-spaces. It has been shown by Dr. Lindsay Steven that a spreading lymphatic inflammation may start from such a point of infection and reach the ureter or kidney. He has demonstrated that the lymphatics beneath the capsule of the kidney and in the superficial part of the cortex can be injected from those of the ureter, and that these again are continuous with those of the bladder. He has also demonstrated, in a case of fatal cystitis, the presence of the micro-organisms in the lymphatics of the bladder, ureter, and kidney. An organism which thus widely invades the lymph-spaces is evidently pathogenic. In its mode of invasion and spreading it closely resembles the micrococcus of erysipelas. It was long ago suggested by Dr. Goodhart that some cases of secondary nephritis might be erysipelatous in character; and he brought forward evidence to show that pyelo-nephritis occurred with greater frequency during epidemics of erysipelas than at other times. There is no doubt also that it is very common to find streptococci indistinguishable from those of erysipelas in foul urine. It is quite probable, therefore, that some cases of secondary nephritis may be due to the same virus as phlegmonous erysipelas. The septic and pathogenic organisms which are the immediate cause of these fatal complications of disease of the bladder may find their way into the urine in two ways. Entering by the alimentary canal or respiratory passages, they may be eliminated from the kidney; or they may enter directly by the urethra. The former mode of entrance is undoubtedly of rare occurrence. Watson Cheyne has shown that, after injecting large quantities of micrococci into the veins, they are found in the renal tubules and urine; but any condition analogous to this is extremely rare in the human subject. The ordinary staphylococci of suppuration have been found in the urine in ulcerative endocarditis with multiple abscesses throughout the body. On the other hand, very numerous observations have shown that in health and in disease the urine is, as a rule, free from organisms unless it be contaminated from without. Under normal conditions, the entrance of organisms by the urethra is prevented by the regular washing of the canal with healthy acid urine. It has, moreover, been shown by experiment that, unless there is previously some slight catarrhal inflammation of the bladder or urethra, it is difficult for the organisms to obtain a lodgment. The presence of mucus adhering to the passages, which is not washed away at each act of micturition, is almost an essential condition for infection of the bladder by the urethra. The development of the organisms is also favoured by an alkaline condition of the urine. In cases of catarrh of the bladder due to gout, stone, stricture, &c., it is very difficult to prevent decomposition of the urine, as the passages are always lined with a layer of mucus, and the organisms may thus find their way in without the introduction of any instrument. They are, perhaps, more frequently carried in by impure catheters or other instruments; and it must be remembered that the passage of an instrument sets up commonly in a urethra not accustomed to it a slight catarrh, which is favourable to the invasion of micro-organisms. The organisms having found their way in and established septic cystitis, the mischief commonly remains limited to the bladder, as the valved orifices of the ureter, which are never incompetent, prevent its further extension, in the great majority of cases, otherwise septic cystitis would be much more fatal than it is. Extension to the ureter seems most probably to be due to catarrh of the pelvis of the kidney and ureter, in consequence of which threads of mucus may come to lie with one end in the foul bladder and the other in the ureter; and by means of these the organisms may find their way into the upper urinary passages, and afterwards extend even into the substance of the kidney. In such cases we find, after death, ammoniacal urine in the pelvis of the kidney. Microscopic examination shows the presence of micrococci in the renal tubules. Whenever acute inflammation of the kidney with multiple abscesses is found, secondary to disease of the lower urinary tract, it is now practically proved that the process is due to the invasion of the organ by micro-organisms. From what has been said above, it will be seen that these organisms may reach the kidney by three paths—first, by direct extension from the bladder along the ureter (this is a simple septic process, and not truly infective); secondly, by the lymphatics (this is an infective process, resembling some forms of erysipelas); and, thirdly, by the blood-stream from a local centre of ulceration or suppuration in the bladder (this is pyæmic, and does not come within the scope of the present article).

Anatomical Characters.—There are four forms of renal affection which may result from the foregoing sources of irritation.

I. *Chronic interstitial inflammation, followed by absorption of the medullary portion, and later on by stretching and thinning of the cortex, without pyelitis.*—This condition is the uncomplicated effect of obstruction to the free flow of urine, and of the consequent increased urinary pressure. It is most frequently met with in cases of pressure on the ureter from without. In diseases of the bladder and urethra it is almost always complicated by an acute attack of interstitial inflammation, which is the immediate cause of death, and which more or less conceals the appearances about to be described. In the early stage there is slight dilatation of the ureter and pelvis of the kidney. The kidney itself is increased in size; the capsule separates without difficulty, but may leave the surface somewhat wanting in its natural smoothness. The venous stars on the surface are often clearly marked, the cortical substance being of a pale pinkish white or sometimes yellowish colour. On section the cortex is found to be wider than natural; sometimes considerably so. The medullary portion is usually pale, like the cortex, but the large veins at the cortico-medullary junction are often distended with blood. The kidney-substance is tougher than natural. The Malpighian bodies can usually be clearly seen, sometimes as red dots. Microscopic examination shows an overgrowth of the interstitial connective tissue. Between the tubules, and especially around the Malpighian bodies, are crowds of small round cells. In consequence of this new-growth, the kidney is somewhat squeezed within its capsule, and as soon as the heart's action ceases the smaller vessels empty themselves. Hence the distended condition of the veins, and the anæmic appearance of the cortex. The epithelium shows no change. The next stage observed is commencing absorption of the medullary portion; the ureter, pelvis, and calices become still more distended; the papillæ are first flattened, and then the pyramids become hollowed out. This is a process of pure absorption, there being no ulceration. The cavity formed by the dilated calyx, and the hollow left by the disappearance of the pyramid, are lined by a continuous smooth layer of opaque white mucous membrane. In the final stages the cortex in its turn becomes thinned and stretched, until at last the whole kidney may be dilated into a large sac, one side of which is smooth, being formed by the thickened walls of the dilated pelvis, the other deeply sacculated, each sacculus corresponding to a lobe of the kidney. On this side the wall is formed of the thinned and stretched cortex, sometimes no thicker than a shilling, to which the capsule, now thickened and opaque, is firmly adherent. In the later stages the microscope shows the same abundant small-cell infiltration, with the development of a greater or less amount of fibroid tissue. The Malpighian bodies show marked changes. The capsules, instead of being delicate and membranous in structure, become greatly thickened, apparently by dense fibroid tissue formed round them in concentric layers. As this change progresses the vessels may become strangulated and finally obliterated; and the corpuscle then shrivels, and comes to be represented by a circular body almost homogeneous in the centre, but marked by a few curved lines indicating the situation of the obliterated vascular tufts. Round this centre is a concentrically laminated layer, formed by the thickened capsule. Even in the most advanced stages the epithelium of the convoluted tubules shows remarkably little change beyond being somewhat flattened.

If at any stage obstruction to the free flow of the urine be removed, the process ceases. The new tissue between the tubules undergoes development into dense fibroid tissue, the process being accompanied by great contraction. The kidney, from being increased in size, may thus become much smaller than natural, excessively tough and puckered, and irregular in form. If the distension have reached the most extreme stage before the primary disease is relieved, the kidney may come to be represented merely by a small nodule of dense fibroid tissue.

II. *Acute diffuse interstitial nephritis without suppuration.*—In this variety both kidneys are usually affected. The kidney is increased in size, and the surrounding fat is sometimes œdematous and adherent to the capsule. When removed, the capsule separates without difficulty, but often leaves the surface coarse; it is somewhat opaque, and often marked with ramifying vessels. The surface is usually of a pale, yellowish-white colour, often mottled with dark red, or in some cases the red may greatly predominate. The mottling often corresponds to the bases of the lobules of the gland, some of which are paler than others, in consequence of the more advanced condition of the interstitial inflammation. On section, the cortex presents the same colour and mottled appearance as the surface, and is evidently swollen. The pyramids may be pale, but are often dark red, contrasting strongly with the paler cortex. The Malpighian bodies are usually clearly visible, and may show on the cut surface as red dots. The consistence of the kidney-substance is unnaturally soft, unless previous to the acute attack it has been indurated by the chronic process first described. The pelvis may be merely dilated, its mucous membrane opaque, and its contents free from decomposition, but more commonly it is marked by ramifying vessels, and presents evidence of chronic congestion, in the form of pigmentation, thickening, and induration. In other cases it is intensely injected, and sometimes covered with a membranous exudation mixed with phosphatic deposit. In these cases the urine and mucus it contains are in a state of decomposition. In consequence of the pallor of the kidney sometimes met with as a result of the emptying of the vessels after death, this form of kidney may, without the microscope, be confounded with the large white or the fatty kidney.

On microscopic examination the following conditions are found. Between the tubules is a very abundant accumulation of small round cells. These are especially abundant round the Malpighian corpuscles. So far it is merely an intensification of the condition described as resulting from increased urinary pressure. The change is not uniform; every field of the microscope varies. In one part the renal structure may appear almost normal, and close by the new cells may be heaped up to such an extent as nearly to conceal the tubules. In the pyramidal portion a similar condition is met with. The renal epithelium throughout is slightly more cloudy than natural, and somewhat swollen, but the nuclei of the cells are readily to be seen in sections prepared in the ordinary way. The adhesion of the epithelium to the membrana propria is somewhat lessened, so that unless considerable care be taken it will wash out in preparing the specimen. Fibrinous casts may be seen here and there in the tubules; and occasionally small round cells, resembling those outside the tubule, may be seen within it. Signs of previous chronic change are often met with, such as dilatation of some of the straight tubules, and obliteration of some of the Malpighian corpuscles.

III. *Acute interstitial nephritis with scattered points of suppuration.—Suppuration of the kidney, Suppurative nephritis, or, when accompanied by pyelitis, Pyelo-nephritis* (*Rayer*); *Uroseptic kidney* (*Dickinson*); *Parasitic kidney* (*Klebs*).—This form of surgical kidney is by far the most common. It is the usual cause of death in fatal cases of disease of the bladder or urethra, in which putrefaction of the contents of the bladder has occurred. It thus comes to be one of the most common fatal complications in cases of injury or disease of the spinal cord, with paralysis of the bladder. It has been frequently stated that it is invariably associated with putrid urine in the pelvis of the kidney, and septic pyelitis; but cases are undoubtedly occasionally met with in which the condition is well-marked, and yet the pelvis is free from inflammation, and its contents are healthy. The naked-eye appearances of acute suppurative nephritis are the following: The surrounding fat may be œdematous and unnaturally adherent to the capsule. The whole kidney is considerably swollen, and its substance soft. The capsule is opaque and thickened, and marked by fine ramiform injection. It separates easily, but tears the kidney-substance in so doing. As it peels off, yellowish-white spots, surrounded by a red zone, come into view. Some of these are minute drops of pus escaping from the small abscesses as the capsule is stripped off, others are on the point of breaking down into pus, but are still solid. These abscesses are grouped together in areas corresponding to the bases of the lobes of the kidney. If the veins can be recognised, the abscesses will often be seen to correspond to the points at which the interfascicular veins appear on the surface. On section, the cortex is seen to present much the same appearance as in the last form of kidney, but in addition yellowish streaks are seen passing from the points of suppuration deeply into the cortex, and often into the medullary portion. These streaks correspond to the course of the interfascicular vessels. They differ from embolic infarcts in their great length compared to their breadth. The pelvis is usually in a condition of most intense inflammation, and the mucous membrane is often covered with a layer of exudation mixed with phosphates. Its contents, composed of urine, blood, and mucus in a state of decomposition, are excessively foul. Cases, however, do occur in which a similar condition of suppuration in the kidney is met with without pyelitis. In these it is probable that the pyogenic irritant has reached the kidney by means of the lymphatics.

Occasionally the kidney is found to be surrounded by a large abscess, arising from a perforation of the pelvis. More frequently one of the superficial abscesses in the cortex bursts beneath the capsule, and gives rise to a large collection of pus separating the capsule from the kidney.

The microscope shows the small-celled infiltration between the tubules in a still more intense form than in the varieties before described. In the areas of suppuration the kidney-substance has entirely disappeared, and its place is occupied by leucocytes packed closely together. In the central parts of these accumulations of small round cells the intercellular substance has softened. and the formation of pus has taken place. The amount of general interstitial change varies considerably; sometimes between the areas of suppuration the kidney-substance is almost healthy, in other cases there is a very marked general interstitial inflammation. The epithelium appears to take no part in the formation of the new cells. It is cloudy and swollen, but undergoes no proliferation. In the straight tubules it is often found to have been thrown off. Wherever suppuration is taking place micrococci can be demonstrated, and for this reason Klebs, who was the first to observe this fact, suggested the name of 'parasitic nephritis' for this condition. They are found chiefly in the tubules. In those cases in which decomposing urine is present in the pelvis of the kidney, many of the straight tubules are found completely plugged with dense masses of these organisms, and a similar condition may be found even in the convoluted tubes of the cortex. The micrococci are also found in the lymph-spaces between the tubules in the pale streaks reaching from the medulla to the cortex. In pyæmia, colonies of micrococci are very commonly to be seen plugging the looping vessels of the glomeruli, and occasionally some may have found their way into the tubules; but in the form of suppuration of the kidney that we are now considering the organisms are not found in the blood-vessels. The various ways in which the organisms may reach the kidney have been already described. That the diffuse inflammation and suppuration in pyelonephritis are due to the invasion of the kidney by these micro-organisms, and to the irritation caused by the chemical products of their growth, is now universally accepted as true.

The lines of inflammation, as before stated, follow the course of the interfascicular veins, and the lymphatics also follow the same direction. In the pyramidal portion thrombosis of the small veins is occasionally met with, but this is probably merely secondary.

If such an acute condition as is above described be set up in a kidney already altered in form by dilatation from increased urinary pressure, the appearances will, of course correspondingly differ.

IV. *The cicatricial kidney.*—This is the result of recovery from one of the preceding conditions, probably only from one or both of the first two, as, if the disease reach the stage of suppuration, the patient is hardly likely to survive. The kidney is shrunken, irregular in form, and marked by deep cicatrices. The substance is excessively tough, and the capsule firmly adherent. Small cysts may be scattered through its substance, which are supposed to result from strangulation of the tubules. The microscope shows a great excess of dense fibroid intertubular substance, and numerous obliterated glomeruli are met with.

The varieties of kidney here described may be combined in various ways. Thus a dilated kidney may suffer from acute diffuse interstitial inflammation, with or without suppuration; or a cicatricial kidney may, from a return of the primary disease, again suffer from an acute attack. It seems probable that increased urinary pressure, combined with considerable reflex irritation, is quite sufficient to give rise to a degree of interstitial nephritis which is incompatible with life; but suppuration only takes place when the kidney is invaded by septic or pathogenic organisms. The extension of decomposition of urine from the bladder to the pelvis of the kidney is alone a sufficient cause for disseminated suppuration of the kidney; but both the extension of decomposition, and its more serious consequences, are greatly predisposed to by the effect produced on the kidney by the first two causes of irritation; in fact, it is comparatively rare to meet with cases in which septic suppuration occurs in a kidney previously perfectly healthy.

Symptoms.—Simple chronic interstitial inflammation, with dilatation of the kidney from increased urinary pressure, gives rise to but few symptoms, and is very difficult to recognise. The most important signs are, that the quantity of urine secreted is increased, and its specific gravity lowered. To avoid error, the whole urine passed in twenty-four hours should be collected, and the specific gravity taken. Single observations are open to numerous fallacies. There may be a trace of albumen, or it may be entirely absent. In one very marked case discovered after death at University College Hospital, the urine had a specific gravity of 1·009, and was free from albumen. A few hyaline casts may be present, but they are by no means constant. The exact state of the urine is often concealed by the mucus, blood, and pus from the lower urinary tract. It is surprising how much urine is secreted by a kidney which is reduced to a mere sac, with no pyramids and a cortex no thicker than a shilling. In a case that came under the observation of the writer, there had been no diminution in the secretion, and the specific gravity was 1·008. In some cases the distended kidney may be recognised by palpation, but this is not common. There are, in fact, no definite symptoms, either subjective or objective, accompanying this form of renal disease. It is not accompanied by hypertrophy of the heart, nor by marked increase of the arterial tension.

Subacute interstitial nephritis gives rise to more marked symptoms. It runs an irregular course, often lasting for weeks or even months, and terminating either in recovery, or in a final acute attack with suppuration. If the disease arise as the direct result of some operation on the lower urinary tract, its commencement is usually marked by a rigor; in other cases it comes on more gradually, with frequent chills but no actual rigor. The temperature is high at night, reaching 101° to 102° F., but it falls towards morning, so that if it be only taken at that time, the elevation may be completely overlooked. The patient becomes weak and languid, and emaciates rapidly. He loses appetite, and there may be nausea or occasional vomiting. There may be diarrhœa, but this is by no means constant. The mouth becomes clammy, and the tongue foul, with a tendency to dryness. In severe cases the tongue becomes dry and brown, and sordes form on the teeth and lips. The skin is usually moist and clammy, and there is not the dryness so frequently met with in other forms of renal disease. There is no œdema. In some cases the swollen kidney may be felt by palpation in the loin, and tenderness may be elicited on deep pressure, but this is by no means constant. The patient may complain of pain in the lumbar region, but this symptom is of little value, as it is often absent, and may arise from many other causes than renal disease. The pulse presents nothing characteristic. The patient frequently sinks into a drowsy state, somewhat resembling the effect of an overdose of opium; but true coma is rarely, if ever, present, and convulsions never occur. The urine is passed in fair quantity, often in excess of the normal amount. The amount of albumen is never very great, but it is usually difficult to estimate accurately how much is renal, and how much is derived from blood or pus from the lower urinary tract. Microscopic examination may show hyaline casts, or occasionally pus-casts; renal epithelium is also frequently met with; but all microscopic examination is rendered difficult by the presence of mucus and pus from the lower urinary tract. If the primary disease be either removed or relieved by treatment, the symptoms gradually subside; if not, they remain without much change till the patient gradually dies exhausted, or an acute attack, rapidly leading to suppuration of the kidney, puts an end to the case.

Acute interstitial nephritis with suppuration most frequently forms the fatal termination of the variety of disease just described, but it may occur without any previous symptoms. The invasion is marked by a severe rigor, often occurring within a few hours of some operation on the lower urinary tract. The rigor is accompanied by great elevation of temperature, and followed by profuse perspiration, during which the temperature falls, perhaps below normal; but it soon rises again, and remains slightly raised, with evening exacerbations. The rigor may be repeated during the progress of the case at irregular intervals. The general symptoms resemble in every respect those just described as indicative of subacute interstitial nephritis, but they are increased in intensity. The strength rapidly fails, there is great emaciation, the pulse becomes feeble, and the tongue 'like a piece of broiled ham.' There may be occasional vomiting and diarrhœa. As the fatal termination approaches, the temperature falls often considerably below normal, the skin becomes cold and clammy, and the patient sinks into a drowsy condition, seldom deepening into actual coma. Although the patient is often said to be dying of 'uræmia,' there are none of the uræmic symptoms observed in acute Bright's disease. There are no convulsions or actual coma, and no œdema. The urine is usually so foul as to defy accurate examination, either chemically or by the microscope. It is secreted in fair quantity to the end of the case. Pus and blood are always found in it, but it is impossible to say whether they come from the kidney or from the lower urinary tract. Renal epithelium and pus-casts are occasionally met with.

It will be seen from the above description that the symptoms closely resemble those of septicæmia, and it is very probable that blood-poisoning, from absorption of the putrid matter in the pelvis of the kidney and lower urinary tract, is, in fact, an important factor in the disease.

Suppression of urine following operations on the lower urinary tract is a well-recognised, but fortunately rare cause of death. In such cases the kidney is always found to be intensely gorged with blood, and the microscope reveals the signs of previous chronic interstitial inflammation.

Urethral fever is a name given to the febrile disturbance, accompanied by a rigor, which so often follows operations on the lower urinary tract. It is impossible to discuss here the innumerable theories which have been put forward from time to time to explain its origin and nature. It is most probable that it is due to a passing congestion of the kidney arising as a reflex phenomenon, as described in the earlier part of this article. *See* URETHRAL FEVER.

DIAGNOSIS.—As before stated, the diagnosis of the more chronic secondary renal conditions is frequently impossible. A careful observation of the case for a few days will usually suffice to determine the presence of subacute consecutive renal inflammation. The acute form with suppuration may resemble *pyæmia.* From this it may be distinguished by the absence of secondary inflammations in the joints, subcutaneous tissue, and lungs; by the lower temperature, falling towards death; and by the early and excessive dryness of the tongue. Pains 'all over the body' are often complained of in pyæmia, while in suppurative nephritis the patient is usually free from pain, except such as may arise from the local disease. With the greatest care in observation, however, the diagnosis may remain doubtful till death. From *septicæmia* it often cannot be distinguished, for doubtless blood-poisoning from absorption of the putrid matter in the kidney is an important element of the disease in many cases.

PROGNOSIS.—This depends, in the chronic or subacute form, entirely upon the possibility of removing or relieving the primary disease. After suppuration has commenced in the kidney, it is very doubtful if recovery ever takes place. If decomposition has extended from the bladder to the pelvis of the kidney, the patient's chance of recovery is much reduced. It is sometimes possible to ascertain this in the following way: Wash out the bladder carefully with diluted Condy's fluid until the solution as it comes out of the bladder retains its purple colour. Then leave the catheter in for a few minutes, and examine the first drops that flow from it. If these are clear and acid, it is evident that the decomposition is still limited to the bladder.

TREATMENT.—The most essential element of the treatment is to remove the cause if possible, but the act of doing so is seldom unaccompanied by the danger of increasing the disease, involving, as it often does, severe operations upon the urinary organs, as lithotomy, lithotrity, or internal or external urethrotomy. These operations would of course, if possible, be avoided if the renal symptoms were at all marked. The fatal termination being in almost all cases associated with putrefaction of the urine in the bladder, and extension of the putrefactive process to the pelvis of the kidney, it is needless to point out that our best hope of preventing consecutive renal inflammation lies in the prevention of decomposition in the bladder, by scrupulous attention to cleanliness in the instruments used. This cannot be too much insisted upon in the management of cases of paralysis of the bladder from injury or disease of the spinal cord. Actual cleanliness can only be obtained by the use of antiseptics. For this purpose all catheters should be washed in some powerful antiseptic lotion, and when used should be greased with carbolic oil (1 to 10) or some other antiseptic preparation. Perhaps the best preparation is that recommended by Mr. Lund, composed of carbolic acid 1 part, castor oil 4 parts, olive oil 12 parts. If decomposition should occur in the bladder, antiseptic lotions must be injected, in order, if possible, to restore the healthy condition before extension has taken place to the kidneys. The best solutions for this purpose are 3 grains of sulphate of quinine, 3 minims of diluted sulphuric acid, water up to a fluid ounce, 1 fluid drachm of Condy's fluid to 10 fluid ounces of water; and boracic acid or thymol solution (saturated). Carbolic acid is rather too irritating, as also is chloride of zinc. After washing out the bladder, two or three drachms of an emulsion of iodoform in gum water, 20 grains to the fluid ounce, may be injected and left in. This is especially useful when the urine is very foul.

If the symptoms of subacute interstitial nephritis are present, the patient will frequently derive much benefit from a pure milk diet. At the same time small doses of opium seem to promote the action of the skin, and so to relieve the kidney without producing the dangerous effects so much to be feared in Bright's disease. The action of the skin may at the same time be still further promoted by vapour baths. The bowels should be kept freely open. Counter-irritation, either by dry-cupping or mustard poultices over the loins, followed by hot fomentations, is frequently of use. If the urine is foul, it may be greatly improved by the administration of benzoate of ammonium or benzoic acid in ten-grain doses every six hours. When the symptoms of the acute form are well-marked, operations to relieve the cause only hasten the fatal event. By careful nursing, and the treatment above described, the symptoms may be so far reduced in intensity as to render an operation for the removal of the cause justifiable.

MARCUS BECK.

SWEAT-GLANDS, Diseases of.—*See* SUDORIPAROUS GLANDS, Diseases of.

SWEATING, Disorders of. — *See* SUDORIPAROUS GLANDS, Diseases of.

SWELLING.—SYNON.: Fr. *Gonflement*; *Tuméfaction*; Ger. *Schwellung*.—This term, when employed in medicine, is applied both to the process and to the condition of increase in volume of any part of the body. In a small number of instances swelling is a normal process, and may be periodical; for example, the swelling of the mammæ at puberty, during menstruation, and in pregnancy; of the uterus during gestation; and of the penis during erection. As a rule, however, swelling is a morbid process or condition, and many examples of it are afforded by disease. These may be broadly classified as—(1) *Local* or *circumscribed*; and (2) *General* or *diffused* swelling.

1. *Circumscribed.*—The most important varieties of this kind of swelling are: (1) Simple *hypertrophy*, as of the thyroid gland in some forms of goître; (2) Swelling due to *disorders of the circulation or inflammation*, as in mechanical congestion of the liver, and in ordinary abscess; (3) *Œdema*, and certain other rarer exudations into the connective tissues; (4) *Extravasations* of blood, urine, gas, and other products; (5) *Dilatation* or *distension* of natural cavities or vessels, as of the serous sacs and joints by effusions of any kind, of the stomach and bowels by gas, of an artery in aneurysm, and of the jugular veins in tricuspid disease; (6) *Disturbed relations* of parts, as in dislocation of the joints, and in hernia; (7) *Retention* and *accumulation* of natural secretions and excretions, as of urine in the bladder, and fæces in the bowels; and (8) *New-growths* or tumours proper, including cysts and parasites. Inflammatory enlargements and new-growths constitute by far the most common causes of local swelling.

2. *Diffused.*—Infiltrations of the subcutaneous connective tissue constitute the principal varieties of swelling that fall under this head. Such are anasarca, myxœdema, general emphysema, and the much more uncommon cases of general swelling of the body which result from the stings of certain plants and animals, and the use of poisonous food.

'*Cloudy swelling*' is a term applied in morbid histology to a condition of the cell, in which it appears at once enlarged and finely granular, as in parenchymatous degeneration or inflammation (*see* DEGENERATION). '*White swelling*' (*tumor albus*) is a popular name for scrofulous disease of a joint, usually of the knee.

The *treatment* of swelling depends entirely upon its cause. J. MITCHELL BRUCE.

SWINE-POX.—A form, possibly, of modified small-pox, in which the pock completes its development imperfectly. It forms a pustule, but the pustule neither umbilicates nor maturates. Willan termed this kind of pock *varicella globularis*; whilst popularly it has also been called 'hives.' *See* CHICKEN-POX; and SMALL-POX.

SYCOSIS. — SYNON.: *Acne Mentagra*; Fr. *Sycose*; Ger. *Bartfinne.*

DEFINITION.—A form of folliculitis confined to the hairy parts of the face.

SYMPTOMS.—Sycosis is a somewhat rare disease. It usually begins on the chin or upper lip, where it is apt to occupy the central part; it is, however, by no means limited to these regions. A similar form of follicular inflammation may attack the whiskers, eyebrows, and eyelashes. In an early stage the eruption consists of acneiform papules or tubercles, which sooner or later develop into pustules with a hair passing through the centre of each. As the number of these increases, the skin assumes a swollen and thickened appearance. In acute cases the infiltration and thickening are considerable, in more chronic forms but slight. In most instances the hairs are not very easily extracted, unless the free suppuration extends deep down into the follicle. In cases of long standing the inflammation leads to a complete destruction of the sac, and the formation of scars and permanently bald spots.

DIAGNOSIS.—In the diagnosis of this disease, the following points should be especially remembered. (1) It is confined to adult males. (2) It generally attacks in the first instance the upper lip or chin, but occasionally the region of the whisker. (3) It is strictly confined to the hairy parts. (4) The papules, tubercles, or pustules each have a hair running through them. (5) It is usually a very chronic affection, spreading slowly and lasting for months or years. (6) The inflammation is attended with pain and burning sensations, but with little or no itching. (7) Ultimately the disease, if not cured, leads to permanently bald patches of scar-like tissue; this, however, is prevented by steady epilation.

Sycosis may be easily confounded with impetigo of the chin, especially when the latter is confined to the hairy parts. Impetigo has, however, a much more rapid development than sycosis, and the discharge and crusts are much more abundant. Moreover, the disease is not usually limited to the hairy parts, which is always the case with sycosis. Another disease for which sycosis may be mistaken is tinea tonsurans of the beard. The chief points of distinction are that tinea generally begins with a circinate patch, and spreads much more rapidly than does sycosis. Subsequently, when suppuration is free, the differential diagnosis is more difficult. The hairs, however, in tinea come out more easily, and present some of the characters of tinea tonsurans of the scalp, and their microscopic examination will readily determine the presence of the fungus.

TREATMENT.—There is only one way of curing chronic sycosis with any certainty, and that is by steady epilation. The best plan is first to remove all crusts with oil and poultices. This softens the skin and renders epilation less painful. The hair of the part affected should be cut rather short with a pair of scissors, and then, wherever a yellow point is seen, the hair passing through its centre should be pulled out with a pair of depilatory forceps. These hairs usually come out with their sheaths attached. When this has been done over a limited area, dilute citrine ointment should be applied. At first, epilation should be confined to extracting those hairs only which pass through pustules; afterwards, however, the parts affected should be completely denuded of hairs by the extraction of a small number every day. This process is attended with considerable pain, and the patience and perseverance of the patient are severely taxed. The young hairs which appear some time after epilation should be also removed, and the process continued until the skin is healthy; after each removal, mild citrine ointment may be applied. Perseverance in this plan of treatment invariably cures the disease; whereas, if left to itself, it leads in the end to the total destruction of the hair, and the formation of permanent cicatrices. The process of cure, however, is extremely tedious. ROBERT LIVEING.

SYMMETRY, in Relation to Disease.—Certain diseases and degenerations manifest themselves in changes of structure which are arranged symmetrically in correspondence with the symmetrical construction of the body. They appear most frequently in bilateral symmetry, in corresponding parts of the right and left sides. More rarely they appear, not only in this bilateral symmetry, but in an arrangement accordant with the homologies of parts in their relations to the longitudinal vertebral axis of the body, as the soles and palms, the knees and elbows.

The most marked symmetry is found in the group of senile degenerations; as in thinning of the hair and baldness, in wasting and wrinkling, and the arcus senilis. It is scarcely less complete in the less simply degenerative changes of atheromatous arteries, and the wasting and increasing fattiness of senile bones. In atheromatous arteries, also, the homologous symmetry, as well as the bilateral, is often seen; the changes in the radial corresponding with those in the peroneal, and those in the ulnar with those in the anterior tibial.

Among symmetrical diseases, the best examples are seen in chronic rheumatic arthritis or osteo-arthritis, rickets, psoriasis, ichthyosis, pityriasis, neurotic pigmentations, the eruptions of secondary syphilis, and those produced by iodide of potassium and some other medicines or poisons.

Chronic rheumatic arthritis shows the best instances of symmetrical changes coincident in many different structures; for instance, in the fibrous degeneration and wasting of cartilage, the thickening and fringed growths of synovial membrane, the nodular formations on the bones. In psoriasis, whether syphilitic or not, there are often good examples of the coincident homologous and bilateral symmetries.

Instances of symmetrical diseases less marked or less constant than these are seen in the deformities of gouty hands and feet, in the thickenings and contractions of palmar fasciæ, in scrofulous lymphatics of the neck or groin, in scrofulous hands and feet, in many cases of eczema, in symmetrical gangrene, and in cartilaginous tumours of the hands and feet.

Significance.—The chief interest of the study of symmetrical degenerations and diseases is in their illustration of some principles of pathology.

The symmetry of senile degeneration is an indication and result of the exact and perfectly maintained uniformity of bilateral changes occurring in the natural life of each symmetrical body. As the two lateral halves, from the embryo state onwards to the state of fullest vigour, pass through changes which are, in each half, progressive at the same rate and in the same method, so that (speaking generally) the two halves are always alike in size, structure, and composition, so is it in decay or degeneration. From beginning to end of normal life the two lateral halves keep time in their similar and equal changes: the changes which are symmetrical are as exactly synchronous. Thus, the senile or timely degenerations of structures are in accordance with the laws of healthy life; and their uniformity is the more notable because they indicate, as do some symmetrical diseases, that the two lateral halves of the body are more alike in method of life and probably in composition than they are in size and shape. Exact similarity in shape and size in the two lateral halves of any organised body is, indeed, hardly to be found. Leaves are never mathematically symmetrical. The corresponding limbs are very often unequal in length and circumference. The difference in the lower limbs is often sufficient to give an appearance of spinal curvature. And in faces exact symmetry is very rare: one eyebrow is commonly higher than the other; the septum of the nose is rarely median; the mouth often not horizontal, especially in emotional movements; or one half of the lower jaw is less nearly rectangular than the other, and that side of the face is the smaller or the more oblique. Yet, in parts unlike in shape or size degeneration may appear in perfect symmetry. It is in the exact similarity of composition and method of life, thus shown to exist in corresponding parts of the two halves of the body, that we find the explanation of most of the symmetrical diseases.

In the list of those diseases which has been given, and which includes the best examples of the group, some may, perhaps, be regarded as instances of 'monstrosity by excess,' deviating very widely from the normal type. Such may be the irregularly symmetrical cartilaginous tumours of the hands and feet. The rest may very probably be ascribed to alterations in the blood or in the nervous force, or in both.

Among the conditions necessary to the normal state and life of each part are the due relations between it and the nutritive materials supplied to it in the blood. In symmetrical and exactly similar parts these relations are exactly the same; and as the healthy blood equally supplied to any two symmetrical parts enables them to maintain their similarity in health, so an unhealthy blood may produce in them an equal similarity in disease. It may often be impossible to find what is really the morbid condition of the blood in symmetrical disease; but the existence of such a condition is nearly proved in the eruptions produced by iodide of potassium, in many cases of urticaria, in lead-poisoning, and in cases of gouty and syphilitic eruptions.

Similar considerations may show that symmetrical disease is due to an altered state of the nervous force. A certain healthy state of this force is a necessary condition of the healthy maintenance of every part; and as the cerebro-spinal nervous system and the ganglionic nerves associated with it are arranged in a bilateral symmetry, so it may justly be held that, as a rule, the nervous force is in all symmetrical parts present in exact likeness. A general disturbance of the nervous force, or any central disturbance transmitted along symmetrically arranged nerve-fibres, would, therefore, generate symmetrical disease; and this, whether we believe that there are special trophic nerves and nerve-centres, or that the trophic nervous influence is exercised through some special condition of the vaso-motor or other nerve-fibres. In either, or in any case, as a healthy nerve-force in the parts is a necessary condition of their healthy symmetry, so may or must a morbid nerve-force produce a symmetrical disease.

The instances of such diseases in which the disturbance of nervous force is most clear are the symmetrical gangrenes of fingers, preceded by intense neuralgia, and the neurotic pigment-marks of the face and forehead. It is not yet possible to tell whether the disturbance is of vaso-motor or of trophic influence, or whether (unless in a few instances) it is of central origin, or reflected from some previously existing peripheral disease, or is due to some affection of peripheral nerves. But the facts of symmetrical diseases are among the chief of those proving the influence of the nervous system in the production and method of organic disease; and they are mutually illustrative with those of unilateral diseases, such as herpes zoster, whose distribution accords with that of certain nerves, whose disturbance is further indicated by neuralgia.

There thus appear to be among the symmetrical diseases some which may be ascribed to morbid states of blood, and some due to morbid states of nerve-force. But it is probable that in yet more, if not in all, both blood and nerve-force are at fault, the latter chiefly determining the localities, the former chiefly the method and obvious characters, of each disease. The phenomena of many of the diseases may be thus explained better than by referring them to only one disturbing force. There are, indeed, few diseases in which the respective shares taken by blood and by nerve-force in morbid processes can be better studied; few, from the study of which we may more justly hope to attain the means of reconciling the often antagonistic doctrines of a humoral and a neural pathology. James Paget.

SYMPATHETIC (σὺν with; and πάθος, suffering).—This term implies that a part or organ suffers in sympathy with some other part or organ which is diseased. Many disorders which seem, and are popularly supposed, to arise in this way can be traced to obvious pathological causes. Thus, a morbid process may extend directly along blood-vessels, lymphatics, or other tissues; a morbific agent may be conveyed by the blood or lymph from one part to another; or a secondary lesion may be produced by direct nervous influence. There are other cases, however, in which the connexion is not so evident; but it is quite intelligible that organs which are physiologically related may be sympathetically disturbed in pathological conditions. The sympathetic disturbance may be indicated by pain or other subjective sensations; by functional derangements, as of secretions or actions; or by positive organic lesions. The occurrence of such phenomena in corresponding parts on both sides of the body, when a disease has commenced on one side, is sometimes very curious, especially as regards organic lesions. As illustrative of the associations in which the word 'sympathetic' is employed may be mentioned *sympathetic pain*, *sympathetic headache*, *sympathetic cough*, *sympathetic vomiting*, *sympathetic bubo*.

Frederick T. Roberts.

SYMPATHETIC SYSTEM, Disorders of.—Synon.: Fr. *Maladies du Nerf Sympathique*; Ger. *Krankheiten der Nervus Sympathicus.*

Introduction.—This subject can only be treated in a brief and tentative manner, owing to the fact that a wide basis of positive knowledge does not exist. The physiology of the different departments of the sympathetic system of nerves is now only beginning to shape itself, whilst on the side of pathology and morbid anatomy there is even still less of definite knowledge. Thus it happens that for the most part only conjectures, often very insecurely based, are current, or can be said to exist, in regard to the dependence of definite sets of symptoms, or distinct diseases, upon disordered actions or morbid changes occurring in one or other part of the sympathetic system of nerves. These problems are now, however, receiving the attention of many workers, so that before long it is to be expected that our knowledge on this important subject will have become both more extensive and more definite. The present article will, therefore, be confined to some general remarks concerning the anatomical relations and the functions of the sympathetic system of nerves; to the modes in which disorders of its several parts may arise; and to little more than a mere mention of the various morbid conditions which may be principally or in part occasioned by defective or otherwise abnormal activity of one or other department of this great system of nerves. We shall thus be enabled to indicate some of the best-established facts or relations in this direction which have already acquired a clinical importance, and also to indicate the directions in which further advances are to be looked for.

Whilst the sympathetic system of nerves, with its double ganglionated cord and great ganglionic plexuses, is to a certain extent an independent nervous system, its roots, nevertheless, penetrate deeply into the cerebro-spinal axis. The two nervous systems are connected, on each side of the spinal column, by means of double sets of filaments, passing between each of the sympathetic ganglia and the respective anterior spinal nerves with which they correspond, as well as with most of the nerves attached to the medulla oblongata. The fibres in all these filaments of communication are partly afferent and partly efferent. Thus, just as ingoing or centripetal impressions, instead of being reflected from some of the sympathetic ganglia, may pass on to spinal and medullary centres, so may motor or inhibitory impressions pass outwards from these cerebrospinal centres, so as to modify the subordinate motor or secretory influences, emanating from some one or other of the sympathetic ganglia themselves.

From the ganglionated cord on each side of the spinal column, numerous internal branches are given off, which unite with one another, with those of the opposite side, and often with filaments of the pneumogastric nerves, so as to form great plexuses with or without well-marked ganglia, with which the various glandular organs and hollow viscera of the body are in connexion by means of afferent and efferent fibres. Along the course of these visceral nerves many smaller ganglia, constituting subordinate centres, are to be found.

The sympathetic nerves are conducted to and come from the viscera, principally upon and along the course of the blood-vessels.

Some of the nerve-fibres on the visceral blood-vessels, and a much larger proportion of those on vessels going to other parts of the body, belong to a special set of the sympathetic fibres, which, from the nature of their functions, are known as *vaso-motor* nerves. Some of these fibres must have 'afferent' functions for the conveyance of impressions to vaso-motor centres; while others of them will transmit 'efferent' impulses; the two sets together serving to regulate the calibre of the blood-vessels, and consequently the amount of blood flowing through the different vascular territories. These vaso-motor nerves are connected with small ganglia distributed along the length of the blood-vessels, from which, in response to afferent impressions, motor stimuli may issue to such vessels and their branches. Such peripheral ganglia are, however, in subordinate relation with spinal vaso-motor centres, situated along the whole length of the cord, and these in their turn are dominated by a still higher regulating centre, situated in the medulla oblongata (near the lower extremity of the fourth ventricle), which appears to be in relation with all the vaso-motor nerves throughout the body. Modern observations would seem to show that there is another vaso-motor centre in the cerebral cortex, but its exact situation and the nature of its relations with the medullary centre are as yet uncertain.

Dr. Gaskell has shown (*Journ. of Physiol.*, vol. vii.) that all the vaso-motor nerves of the body leave the spinal cord in the anterior roots of the spinal nerves from the second dorsal to the second lumbar inclusive, passing thence into the lateral ganglia of the sympathetic, where these vaso-motor fibres lose their medullary sheaths.

Other fibres of the sympathetic system are intermixed on the vessels with those having a vaso-motor function. These others vary in function and in numerical proportion, according to the nature of the organ to which the vessels are proceeding. Thus to and from the liver, the pancreas, the salivary glands, and other allied organs, would proceed nerve-fibres regulating the secretory and other vital actions taking place in the tissue-elements of the several organs; also from and to such organs there would proceed afferent and efferent fibres for rousing and regulating the activity of the contractile tissues in their respective gland-ducts. Again, there would lie on intestinal arteries, in addition to vaso-motor fibres, many other sympathetic fibres for the innervation of the muscular layers of the intestine, and many also for the different glandular elements of its mucous membrane. Lastly, in such an organ as the bladder, vaso-motor nerves, and nerves for the supply of its own proper muscular tissues, would exist in abundance, while those in relation with glandular elements would be comparatively scarce.

If, therefore, we consider the functions of the sympathetic system of nerves as a whole, we find that it has to do with the degree of contraction of the pupil; with the calibre of the blood-vessels generally; with the activity of all the glandular organs; with the movements of all the hollow viscera, and gland-ducts; and possibly in some special manner with the nutrition of all the tissues. And inasmuch as the nerves pertaining to this system, if not both the nerves and ganglia, are to be found in all parts of the body, it is to be expected that its functions may be more or less locally deranged, or its structure more or less damaged, by almost every form of disease, be it local or general. Every local inflammation must be associated with a perverted activity and deranged structure of sympathetic nerve-fibres in the inflammatory focus; whilst every fever will entail widespread and varied perversions in the functions of this system of nerves throughout the body. Owing, however, to the fact of the intimate structural relations existing between the sympathetic and the cerebro-spinal nervous system (*see* Nervous System, Diseases of), it is more especially in diseases of the spinal cord and of the brain that we are accustomed to meet with definite sets of signs and symptoms referable to disordered or arrested action of portions of the sympathetic system. In the present article, therefore, the disorders of the sympathetic system will be very briefly considered as they occur: (1) in association with diseases of the spinal cord and brain; and (2) independently of affections of the cerebro-spinal nervous system.

1. Diseases of the Sympathetic System in connexion with the Cerebro-spinal System.

(*a*) *The Spinal Cord.*—Lesions of the *cervical* region of the spinal cord may be associated with extreme contraction or extreme dilatation of the pupil on one or both sides; with increased heat and redness, or the reverse, of the head and neck; with perverted respiration; with perverted action of the heart; and possibly with an exalted febrile heat of the whole body (*see* SPINAL CORD, Diseases of, § 7, (*b*), (1–4). Though we regard these phenomena as signs of disease in this particular portion of the spinal cord, it is none the less true that such phenomena are due to altered activities in those root-portions of the sympathetic system of nerves which take origin in, or traverse, this region of the cord. This is shown by the fact that similar sets of symptoms are produced by injuries, tumours, or other morbid processes implicating the cervical sympathetic itself.

It will be well to cite here the phenomena commonly associated with *irritation* or *paralysis* of the cervical sympathetic nerve, on account of their importance as diagnostic indications.

The signs dependent upon *irritation* of the cervical sympathetic in its *oculo-pupillary* fibres are—dilatation of the corresponding pupil with sluggish action, widening of the palpebral fissure, prominence of the eyeball, feeling of tension in the eye (as in glaucoma), and a scanty secretion of tears and mucus; whilst in its *vaso-motor* fibres they are—lowering of temperature of the side of the face and head, diminution of sensibility, an absence of perspiration, with (if the irritation continue) a tendency to slight atrophy of the side of the face. The signs of *paralysis* of the cervical sympathetic in its two sets of fibres are the direct opposites of those just cited, so that it is not necessary to enumerate them. Of these signs, those dependent upon irritation or paralysis of the oculo-pupillary fibres are usually much more constant and durable than those which depend upon irritation or paralysis of the vaso-motor fibres. These latter signs are, for reasons at present unknown, often transitory and fitful. Sometimes there may be signs of paralysis of oculo-pupillary fibres co-existing with signs of irritation of the vaso-motor fibres, or *vice versâ.* It has been definitely determined that injury in the lower cervical region of the cord, and as far down as the level of the *second dorsal* nerve, may give rise to the oculo-pupillary signs of one or other kind; and, on the other hand, that damage to the cord in these same parts, or as low down as the *fourth dorsal* nerve, may give rise to the above-mentioned vaso-motor signs.

When the *dorsal* and *lumbar* regions of the spinal cord are the seats of disease, other groups of phenomena will doubtless, after a time, be more fully recognised as results of irritation or paralysis of those roots of the sympathetic system which have their origin in or which traverse these particular regions of the spinal cord. It is therefore important to bear in mind the place of origin and the distribution of the different internal branches from the lateral sympathetic cords, which proceed from these regions to the different glandular organs or hollow viscera. Diarrhœa, sickness, obstinate constipation, sexual defects, and bladder-troubles, are among the symptoms which have such an origin, as well as undue heat or unnatural coldness of the lower extremities.

The recent researches of Dr. Head (*Brain*, part lxi., 1893) lead him to believe that sensory nerves are received from the viscera and enter the spinal cord over areas very similar to those from which, as Gaskell has shown, motor and inhibitory fibres issue. His conclusions are as follows: 'The sensory fibres enter the central nervous system in three great groups. The highest of these is in the head and neck; the middle group lies between the first dorsal and the first lumbar segments of the spinal cord; the lowest group extends from the fifth lumbar to the fourth sacral segments. . . . Thus there are two gaps in the spinal cord which are not in connexion with sensory fibres from the viscera. The higher of these consists of the fifth, sixth, seventh, and eighth cervical segments, whilst the lower corresponds to the second, third, and fourth lumbar segments.'

He has found, and Dr. J. Mackenzie has arrived at very similar conclusions (*Med. Chron.*, Aug. 1892), that in association with disease of different viscera there are for each certain definite sites of pain, and that these are situated in this or that segmental skin-field, throughout which in certain cases of visceral disease marked tenderness or *hyperalgesia* is to be found. In this way they have been enabled to connect the nerve-supply to different viscera with definite spinal nerve roots.

(*b*) *The Brain.*—In different portions of the brain some of the signs and symptoms of disease are also referable to direct or indirect interference with the functions of the sympathetic system of nerves; but they constitute (apart from vaso-motor derangements, which are very common and often well-marked) far less distinctive aggregates, owing to the fact that the sympathetic system of nerves has a much less extensive relation with the brain than with the spinal cord. In this direction, however, and in connexion especially with diseases of the medulla oblongata, we have to bear in mind the occasional occurrence of diabetes, polyuria, or albuminuria; also of some cardiac and respiratory derangements.

2. Diseases of the Sympathetic System proper.—Where disease exists in the ganglia of the sympathetic system itself, or where it involves them, we get groups of symptoms more clearly referable to disordered activity of this system of nerves alone.

These will differ in particular cases, according to the nature of the morbid change, that is, according as it is destructive or merely irritative; and according to the number or particular combinations of ganglia and fibres affected. The ganglia and related plexuses may either be implicated by *intrinsic* morbid processes, or may be variously involved *from without* by morbid processes having their origin in other adjacent tissues.

(*a*) *Intrinsic changes.*—The principal intrinsic morbid processes which have been hitherto recognised *post mortem* in some one or other of the sympathetic ganglia are: Pigmentary degeneration; cirrhotic overgrowth of their connective tissues, with or without secondary atrophy (the ganglia in such cases being either smaller or larger than natural); a highly congested and varicose state of their blood-vessels; effusion of blood into their substance; new-growths starting from their substance; and fatty degeneration, with more or less marked atrophy. It is unnecessary to repeat here the statements relating to the pathology of such changes, which have been made under NERVOUS SYSTEM, Diseases of.

(*b*) *Extrinsic disease.*—Different parts of the sympathetic system may become involved in new-growths or in abscesses; or they may be simply pressed upon by aneurysmal or other tumours occurring in contiguous regions of the body.

Besides the pathological conditions already enumerated, it should be borne in mind that in altered blood-states, whether cachectic or of febrile origin, we commonly have, and especially in the latter class of cases, a greatly perverted activity of the sympathetic system throughout the body—as evidenced by the altered vascular conditions, increased tissue-metamorphosis and body-heat, together with the perverted activity of most of the glands in the body. *See* FEVER.

But to what extent the actual structure of glandular or blood-making organs may be perverted by primary or secondary morbid changes in related portions of the sympathetic system, we have yet to learn. Waxy degeneration of the liver or spleen may, for instance, be a result of certain perversions of the normal life-processes taking place in the elements of these organs, primarily induced by changes in the quality of the blood, such as occur in many cachexias. But whether this altered blood acts directly upon the tissue-element, and brings about the structural change known as waxy degeneration; or whether cachectic states of the system entail upon the sympathetic centres a perverted nutrition, and a consequent perverted influence upon the tissue-elements of related organs, whereby they, being at the same time fed only by impoverished blood, lapse into those lower modes of vitality which result in the degenerative change above mentioned, are unsettled questions, well worthy of consideration. These remarks, with suitable modifications, are applicable, as regards the possible instrumentality of related portions of the sympathetic system, in causing other varieties of morbid change in other organs of the body.

The principal disorders other than those due to structural diseases of the cord and of the brain, in which derangements of the sympathetic system of nerves exist, or are believed to exist, and in which such derangements have either wholly or in part a causal relationship to the principal signs and symptoms of the respective disorders, are as follows: Epilepsy; convulsions; migraine (hemicrania); exophthalmic goître; unilateral hyperidrosis; progressive facial hemiatrophy; angina pectoris; asthma; diabetes mellitus; Addison's disease; gastralgia; enteralgia (colic); neuralgia cœliaca; neuralgia spermatica; and uterine neuralgia (see *Phys. and Pathol. of Sympath. Syst. of Nerves*, by Eulenberg and Guttmann, 1879; and Long Fox, *The Influence of the Sympathetic on Disease*, 1885). Among the affections more doubtfully or partially related to disorders of the sympathetic, we may mention glaucoma; neuro-retinitis; progressive muscular atrophy; pseudo-hypertrophic paralysis; locomotor ataxy; diphtheritic paralysis; and so-called 'reflex paralysis.' In the special articles on most of the first group of affections, the reader will find references to the dependence of such conditions upon disorders in one or other department of the sympathetic system.

H. CHARLTON BASTIAN.

SYMPTOM: SYMPTOMATOLOGY. — *See* DISEASE, Symptoms and Signs of.

SYNCOPE (συγκοπή, a faint).—SYNON.: Fainting; Fr. *Syncope*; Ger. *Ohnmacht.*

DEFINITION.—A state of suspended animation, due to sudden failure of the action of the heart.

ÆTIOLOGY.—Syncope may be due to any condition which interferes with the action of the heart, whether acting (*a*) *intrinsically*; (*b*) through the *nervous system*; (*c*) through the *blood*; (*d*) through *more than one* of these channels.

(*a*) Syncope due to *intrinsic* cardiac conditions is chiefly seen in structural diseases of the heart, especially fatty degeneration. Amongst other examples of this class of causes may be mentioned compression of the heart by diseased conditions, or by tight articles of dress; excessive heat, whether natural or artificial, as in sunstroke and the warm-bath; lightning; and certain drugs and poisons, including chloroform and tobacco.

(*b*) The most common *nervous* causes of fainting are of an emotional kind, such as fear, grief, or joy, in nervous or hysterical women. Sudden injury of the central nervous system, as in concussion of the brain, has partly the same effect. In a larger number of instances the nervous causes of syncope act reflexly, and are to be found in conditions of the stomach or intestines (corrosive and irritant poisoning, indigestion, worms, scybala); in the liver, kidneys, or uterus (injuries, calculi, displacements); or in the limbs or body generally (painful injuries of any kind). Spasm of the arteries, due to reflex irritation of the vaso-motor nerves (cold and certain poisons), may also lead to syncope.

(*c*) Of the causes of syncope connected with the *blood* the most frequent is hæmorrhage. Chronic anæmia, as seen in idiopathic and pernicious cases, or accompanying chronic constitutional diseases, is a common cause of serious fainting.

(*d*) In a large number of instances, however, the causes of syncope are *complex*. Thus in fainting from hunger and exhaustion the heart is depressed directly, as well as through the nervous system, and through the blood; and in severe injuries, such as railway accidents, there may be a combination of depressing causes, including fear and grief, hæmorrhage, painful lesions, cerebral concussion, and shock. Fainting in a hot impure atmosphere appears to be due partly to the direct effect of heat upon the circulation; partly to the interference with respiration, and indirectly with the heart, produced by carbonic acid and other excrementitious products.

In a person subjected to any of the predisposing causes of syncope already mentioned, the occurrence of fainting may be determined by a very slight exciting cause. It is thus that in serious cardiac disease, in hysterical subjects, and in persons suffering from anæmia, the smallest excitement or exertion, unpleasant sights or smells, or exposure to an impure and heated atmosphere, may cause faintness, and in some instances even fatal syncope.

Anatomical Characters.—In death by syncope the organs generally are found to be anæmic; and this condition is particularly marked if hæmorrhage have occurred. The state of the heart varies with the cause of its failure, the ventricles being either dilated and full of blood, or empty, as in cases of fatal hæmorrhage, and possibly contracted.

Symptoms.—A syncopal attack presents three stages, namely: (1) *a period preceding loss of consciousness*; (2) *a condition characterised by insensibility*; and (3) *a period of recovery* from the fainting state.

(1) A person about to faint is observed to turn suddenly pale; he staggers, or leans against the nearest support; the eyes roll upwards, whilst the eyelids tremble or close; and consciousness and general sensibility are impaired. The pulse fails, generally becoming weak, small, and frequent; in other instances it is infrequent, irregular, or intermittent. The respiration is irregular and feeble. Vomiting may possibly occur.

At the same time the patient has a number of subjective sensations. The most urgent of these are a sense of 'sinking' in the epigastrium, a feeling of increasing debility, 'giddiness' in the head, and a tendency to fall. Vision becomes indistinct; the hearing is usually impaired—rarely more acute, or tinnitus is present. Mentally there is a rapid fading of sensory impressions and of consciousness; whilst in cases of fainting from loss of blood there may be restlessness, agitation, and delirium.

(2) The phenomena of the first stage are now complete. The muscles are relaxed; the patient falls; and consciousness is completely lost. The surface is pallid, and possibly cold and clammy; the eyes are closed, and the pupils dilated; the pulse and the cardiac impulse and sounds are nearly or quite imperceptible; respiration is indistinguishable, or occurs as occasional weak sighs; and the vital functions generally appear to have ceased. In cases of syncope due to severe hæmorrhage general convulsions may occur.

(3) Recovery from syncope is marked by signs of gradually returning consciousness, increase of the pulse at the wrist, and restoration of the functions generally. The first obvious signs of improvement are usually slight movements of the hands and features, and deep sighing. Thereupon the pulse becomes more distinct; the cardiac impulse and sounds are found to be stronger; the senses of sight and hearing can be excited; colour returns to the face and lips, and warmth to the extremities; and intelligence is gradually restored. Very shortly the patient may be able to resume the sitting posture; and the seizure is at an end.

Duration and Terminations.—The duration of the several stages of syncope varies greatly, from a few seconds even to hours. In many instances the attack does not pass beyond the first stage; in rarer cases insensibility may last for an almost indefinite time. The most common termination is in recovery; but syncope is one of the ordinary modes of death, especially in hæmorrhage and organic disease of the heart. In nervous subjects partial recovery may be quickly followed by the return of the fainting state, the patient being said to 'pass out of one faint into another.' Where referable to organic disease or to hysteria, syncope may recur at intervals for many years.

Pathology.—Syncope consists essentially in sudden failure of the action of the heart, originating in any of the causes already mentioned, and leading to the condition of acute general anæmia. Whether from some affection of the heart itself, from sudden interference with the nervous impulses which regulate its action, from failure in the regularity of the supply of blood within its cavities and in its substance, or from a combination of such causes, the systolic contraction suddenly becomes short and feeble. If there has been no hæmorrhage, the result is distension of the cardiac cavities with blood, and further embarrassment; but if profuse hæmorrhage has occurred, the heart may be deprived of blood, and thus of the natural stimulus to contraction. In either case fatal cardiac paralysis may be the result, unless the contractile power be speedily restored.

The acute general anæmia that results specially affects the central nervous system. In the erect posture the circulation fails first within the cerebrum, producing rapid disturbance and then loss of consciousness, and depressing the centres that regulate the heart, vessels, respiration, and stomach. The general muscular paralysis which occurs at the same time is also partly of central origin. Similarly, the convulsions which may ensue in cases of hæmorrhage are probably referable to sudden circulatory disturbance within the basal ganglia and cord. The senses are further obscured by anæmia of their special organs; the heart is more depressed by failure of the coronary circulation; the paralysis of the muscles is increased by want of blood within them; and the temperature falls from failure of the circulation generally.

In non-fatal cases recovery naturally occurs by restoration of the cerebral circulation in the recumbent position, and consequent stimulation of the cardiac centre. Other circumstances favour the recovery of the general circulation, such as the relaxation of the arteries, and the partial restoration of the respiratory and other functions, which quickly re-act upon the heart.

Diagnosis.—Syncope has to be diagnosed from other conditions in which loss of consciousness is a prominent symptom; and chiefly from epilepsy, 'apoplexy' from any cause, concussion of the brain, shock, and poisoning of many kinds, including suffocation by certain gases, and drunkenness. From such of these conditions as commence in the brain, and from poisoning (unless the poisons act as cardiac depressants) syncope is distinguished by the characters of the pulse. Certain cases of hysterical 'faints,' which are strictly cerebral, not cardiac, in origin, are also readily diagnosed by the pulse, which is of good volume and force. The diagnosis of shock, which usually produces a degree of syncope, is described in the article on that subject. *See* Shock.

Prognosis.—The prognosis of syncope depends upon its cause, and upon the practicability of immediate treatment. If due to structural disease of the organs of circulation, or to serious injury, acute poisoning, excessive heat, or profuse hæmorrhage, the case may be serious, and prove fatal unless treatment be instantly applied. If, on the other hand, the cause of the faintness lie in an excitable nervous system, momentarily depressed by some passing emotional disturbance, or by impurity of the atmosphere, the attack may be pronounced free from danger, although liable to recur.

Treatment.—In the treatment of syncope two indications are equally urgent, namely, removal of the cause of faintness, and restoration of the action of the heart. If the patient should not have fallen, he must be immediately laid flat on his back; the atmosphere should be rendered as pure as possible, by throwing open the windows and doors, or by removal to the open air, and by preventing people from crowding around; and the dress should be loosened about the neck, chest, and abdomen. If hæmorrhage have occurred, means must be taken to stop it. Cardiac stimulants, direct or indirect, must then be employed. The most available and powerful of these is alcohol, in the form of brandy or other spirit; and this may be given either pure or in water, and in an amount which will vary with the individual case, as estimated by the immediate result. Sal volatile, ether, and eau-de-Cologne are equally valuable cardiac stimulants, if available. Should the patient be unable to swallow, these substances, as well as warm liquids, must be given at once as enemata; or ether may be injected under the skin. Carbonate of ammonium ('smelling salts') and other strong smelling compounds, including perfumes, fanning, cold douches, and refrigerant applications of eau-de-Cologne or other spirit to the temples and hand, are other ready methods of exciting the heart reflexly through the nervous centres. If these measures fail after a fair trial, the condition of the patient is very serious. The systematic employment of efficient means of resuscitation must then be had recourse to, including friction of the limbs and trunk, inversion, galvanisation of the region of the heart, and even transfusion of blood. *See* Resuscitation (A.).

In cases ending favourably the patient must be careful not to assume the erect position too hastily, or to undergo much exertion, until some rest have been obtained, or some stimulant or nourishment administered.

The occurrence of syncope is sometimes the first indication of the existence of serious organic disease of the heart or other organ; and it should suggest a careful examination of the patient, and the adoption of measures likely to prevent the return of such a dangerous symptom—that is, the avoidance, as far as they are avoidable, of the principal causes already mentioned.

J. Mitchell Bruce.

SYNOCHA.—*See* Synochus.

SYNOCHUS (*συνέχω*, I hold or keep together).—Synon.: *Febris Continens.*

Synocha and synochus are now obsolete terms, which were used for many centuries as epithets of two distinct types of fever, but in different senses at different periods. A complete history of their varying meanings would occupy much space; a few illustrations of it only need be given. *Synocha* does not occur in Galen's extant writings; and *synochus* is by him contrasted with *πυρετός συνεχής*, and defined to be a fever whose course is steady and uniform from its beginning to its end. Under it, in his *Method. Medend.*, lib. ix., cap. iii., he admits three varieties, namely, (1) when the temperature remains steady; (2) when it rises steadily; and (3) when it falls steadily, during the whole course of the fully established disease. The meaning of the term has no reference to the duration of the fever. *πυρετός συνεχής*, on the contrary, is a fever with paroxysms and remissions. Galen, *Definit. Med.*, 186–7.

In the second edition of Stephen Blanchard's *Lexicon*, A.D. 1717, from which the etymology given above is taken, synocha is a continued fever, of several days' duration, with paroxysms and remissions, attended by remarkable heat, and sometimes putrid. It may be either quotidian, tertian, or quartan. By this he seems to mean that exacerbations may take place on those days; but the fever is remittent, not intermittent. Synochus is a continuous fever (*febris continens*), often lasting several days, unattended by serious symptoms, and is either simple or putrid, according to its severity.

Linnæus in 1763, and De Sauvages in 1768, both define synocha to be a fever not lasting more than a week, synochus one not lasting more than two or three weeks.

Cullen, in 1785, dissatisfied, he says, with the previous use of the words, gives to them a special meaning of his own. In his nosology synocha is a fever with very high temperature; a frequent, strong, hard pulse; red urine; and very little disturbance of the sensorium. Synochus is a contagious disease, in which the fever combines the symptoms of synocha and of typhus; beginning as synocha, towards the end it becomes typhus.

With this variety of meaning, it is not surprising that the same disease is placed under 'synocha' by one author, under 'synochus' by another. As the further use of these terms, apart from their incongruity with modern systems of classification, can only perpetuate this confusion, they may be allowed to become obsolete. James Andrew.

SYNOVIAL DISEASES. — *See* Joints, Diseases of.

SYPHILIS (etymology uncertain. Perhaps from *σύν*, with, or *σῦς*, a swine; and *φιλέω*, I love; or from *σίφλος*, crippled, maimed).—Synon.: Vulg., Pox; Fr. *Vérole*; Ger. *Lustseuche.*

Definition.—A specific general contagious disease; communicable by contact of its virus with a breach of surface, or by hereditary transmission. Syphilis is characterised by a period of incubation; and, in the acquired form, by certain changes at the seat of contagion, and in the proximate lymphatic glands. These are followed by an eruption on the skin and mucous membranes, and sometimes by lesions of the deeper tissues and viscera.

History.—The origin of syphilis is unknown. In India and China there is little doubt that the disease existed centuries ago; but the time at which it first appeared in Europe has given rise to much discussion, and is still the subject of dispute. Some writers maintain that syphilis was introduced by the followers of Columbus from the West Indies, on their return from the discovery of Hayti in 1493. Others, again, hold that it first broke out among the French soldiers during the siege of Naples in 1494–5. There can be no doubt that syphilis of a very severe character was prevalent in Southern Europe towards the close of the fifteenth century, when indeed it seems to have been first clearly recognised and described; but it is also probable that the disease had existed even in Europe long before that time.

Ætiology.—The various phenomena of syphilis are caused by the absorption of an infective virus into the blood, and its diffusion throughout the body. It was formerly taught—a doctrine for which John Hunter was largely responsible—that syphilis, the soft chancre, and gonorrhœa were due to one virus. This was more or less generally accepted until 1838, when Ricord's researches confirmed the conclusions arrived at long before by Balfour (1767), and Benjamin Bell (1793), to the effect that gonorrhœa had nothing whatever to do with the other two disorders. The next step was completed in 1852, by the publication of Bassereau's evidence, based on the comparison of a large number of cases of venereal sore with their source of contagion. The results of these observations tended to show that the 'soft chancre' was a local affection, quite distinct from the general disease syphilis. This is the view most generally held at the present day, and those who hold it are now called *dualists.* A small number of authors, however, still maintain that syphilis and the soft sore are products of the same virus, and to such the term *unicist* is applied. The discussion of *unity* and *duality* does not come within the scope of this article. It will be sufficient to state that it is from the more generally accepted or *dualist* point of view that the present account is written. Consequently, when the term 'syphilis' is used, the constitutional disease is always to be understood. The local suppurating sore or soft chancre is described elsewhere. *See* VENEREAL SORE.

One attack of syphilis usually affords protection against a second throughout the lifetime of the individual, but in rare instances, as in other contagious diseases, the same person suffers more than once.

Besides being capable of contaminating others by inoculation, the subject of acquired syphilis is also liable, during a variable period, to transmit the disease to the offspring; but whether the inherited form of syphilis be further transmissible to the next generation remains doubtful.

It is probable that many persons, though exposed to contagion, escape syphilis as they escape other diseases, from want of susceptibility. The reason of such peculiarity is not yet understood.

PATHOLOGY AND ANATOMICAL CHARACTERS. The essential nature of the syphilitic poison is unknown. Certain micro-organisms have been reported from time to time as found exclusively in the blood or tissues of syphilitic persons; but evidence is still wanting to settle the question, one difficulty in the way being that syphilis seems not to be communicable to the lower animals. Syphilis resembles the exanthemata in having a period of incubation, in the development of a rash, and in the protection commonly afforded by one attack against subsequent contagion; but it differs from them in its long duration and liability to relapse, in not being infectious through the atmosphere, and in its capability of being greatly influenced by certain remedies.

When the syphilitic poison has been absorbed, it multiplies until the whole body becomes pervaded by it. How soon this absorption takes place is not known. Excision of the initial lesion has been extensively practised with the object of preventing further development of the disease; but the evidence at present available, from observation as well as from experiment, indicates that by the time the initial lesion appears the virus has already passed some distance at any rate beyond its boundaries.

The changes produced by syphilis have been well described by Dr. Gowers as depending partly on a process of inflammation, and partly on a process of tissue-formation. These two are generally combined in varying degree according to the lesion and according to the stage of the disease. The inflammatory element is most marked in the early eruptions of the skin and mucous membrane, and is also probably the chief factor in causing certain early functional disorders of the internal organs. The process of new-growth is most distinct in what is called *syphiloma* or *gumma*. The change begins by the production of a small-celled growth, which at first resembles granulation-tissue — hence named by Virchow *granuloma*, but which soon shows a marked tendency to vascular occlusion and consequent degeneration.

The new-growth may develop in a diffused infiltrating form, or in the circumscribed masses known as gummata. Any of the structures of the body may be attacked, most commonly, perhaps, the skin and subcutaneous connective tissue; but bone, muscle, the blood-vessels, and the viscera are all liable to suffer; and although the morbid growth is essentially the same wherever it is developed, it presents differences in appearance, as well as in behaviour, according to the tissue or organ affected, and the period at which it occurs.

A *gumma*, which is the most characteristic product of syphilis, in its typical form appears as a yellowish, tough, somewhat elastic, and sharply defined mass, which is often caseous in the middle. Gummata vary greatly in size, from a mere granule to a duck's egg, or even larger still. They may be single or multiple, and are frequently associated with the diffused form of growth, which after a time becomes converted into a tough fibrous tissue; this finally contracts, and thus puckers, deforms, and often seriously affects the functions of the organ in which it grows.

Besides the changes that have just been described, *albuminoid disease* is also caused by syphilis, especially in cases where long-standing suppuration has been present. *See* ALBUMINOID DISEASE.

CONTAGION.—Before considering the different ways in which syphilis may be propagated, it is necessary to mention the vehicles of the virus. These are—

1. The discharge of the initial lesion.

2. The secretions of all the secondary eruptive lesions, especially of those known as mucous patches or tubercles.

3. The blood, during the earlier stages of the disease.

The secretions of the later or tertiary affections have not been proved to be inoculable, nor have the physiological secretions of a syphilitic person—for example, the saliva, sweat, tears, milk—unless mixed with the secretions of syphilis or with the blood, even though the disease be in an early stage. The semen, however, though apparently not contagious in the ordinary way, seems to be capable of infecting the ovum during a period which probably varies considerably in different cases. Lastly, the secretions of other diseases from which a syphilitic person may be suffering are not always contagious. This at least is the case with regard to vaccinia; for healthy children have been often vaccinated from syphilitic ones without contracting syphilis.

Modes of Communication. — The sources of contagion being so numerous, it is easy to understand that the modes of communication must be so also. They may be described under three heads: (1) *direct contact*; (2) *mediate communication*; and (3) *hereditary transmission.*

1. *Direct contact.*—In the great majority of cases syphilis is imparted during sexual intercourse—first, because the genital organs are the most frequent seat of the contagious lesions; secondly, because the delicate epithelium of these organs is especially liable to abrasion during coitus. Hence syphilis is usually described as a venereal disease, but it should always be remembered that it is not necessarily so. Wherever the poison comes in contact with a broken surface, it may thence be absorbed, and general infection follow. Instances of syphilis being conveyed quite independently of sexual relations are unfortunately far from rare. Perhaps the most frequent mode of extra-genital contagion is the contamination of a nurse by a syphilitic child, or of a child by its nurse. The disease may also be spread by kissing, contagious syphilitic lesions being very common about the lips and in the mouth. Again, medical men and midwives not infrequently contract syphilis by attending diseased women in labour; and surgeons by examining or operating upon syphilitic persons.

2. *Mediate communication.*—When syphilis is communicated indirectly, the medium may be of almost endless variety. Articles which are used in common by different persons, such as spoons, drinking-vessels, pipes, &c., are perhaps the commonest media; implements used in various trades—the tubes used in glass-blowing, for example — have also acted in the same way. Again, through the performance of tattooing, cupping, catheterisation of the Eustachian tube, or other operations, by ignorant persons and quacks, the disease has been communicated. It has also happened during vaccination; but in this country, where that operation is performed only by duly qualified medical men, such an accident is of extreme rarity. The mode of communication in which the fœtus is believed to be the medium of contagion between husband and wife, is noticed under the next heading.

3. *Hereditary transmission.*—Our knowledge is still imperfect respecting the transmission of syphilis from parent to child; and the questions involved are much too wide for discussion in this article. Consequently, no attempt will be made to do more than state briefly the facts which are generally accepted, and the most usual course of events when syphilitic persons become parents.

In the first place, it must be remembered that a child born of syphilitic parents does not always show signs of the disease. When the infection of both parents is recent, however, the offspring almost invariably suffers, and this is also the case if the mother alone be diseased. Under such circumstances abortion or premature birth is common. When the father alone is syphilitic, and especially if his disease be not of recent date, both mother and child may escape. Some believe that a syphilitic father may procreate a diseased child while the mother escapes, but it appears most probable that the mother of a syphilitic child does not really escape contagion, although she may show no characteristic signs of the disease. The most weighty evidence in support of this view is that known as 'Colles's law'—namely, that the mother of a syphilitic child does not become infected by it after birth. In the cases where the mother does not show the earlier signs of acquired syphilis, it is believed that the ovum becomes diseased directly by the father, and in turn infects the mother during gestation (syphilis by conception, or '*choc en retour*'). If the mother acquire syphilis during the earlier months of pregnancy the child commonly suffers. If she be infected after the seventh month it is said that the child may escape, but further and more exact evidence on this point is required.

The duration of the transmissive power varies according to the influence of treatment and other circumstances; but the liability to transmit syphilis to the offspring seems to last longer than the ability to infect by inoculation. It is often stated that the children born nearest to the date of parental infection suffer most severely; but this is not always the case. A healthy child may be born while the mother is under the influence of mercury; but a subsequent one may be tainted, if treatment have been discontinued, and the disease have resumed activity. There are also periods of quiescence in syphilis independent of treatment, during which apparently healthy children are sometimes born.

SYMPTOMS.—The symptoms of syphilis are usually divided into three groups—*primary*, *secondary*, and *tertiary*. And although such division is really artificial, it is useful to retain these terms for the purpose of description; but it must be borne in mind that in the great majority of cases tertiary symptoms do not occur at all; that they sometimes appear quite early in the disease; and that the signs proper to all three periods may be present at the same time.

1. **Primary Syphilis.**—A patient is said to be suffering from primary syphilis as long as the initial manifestation, and the accompanying glandular enlargement, remain the sole signs of the disease.

When the syphilitic poison, unmixed with any irritating matter, has been inoculated, the abrasion quickly heals, and no further change is observed for three weeks or a month. This interval is called the period of *incubation.* Its average length, judging from cases of experimental inoculation, is about twenty-four days; but it may perhaps be as short as ten, or as long as forty-six days, or even longer still. After this a small red spot appears at the site of inoculation, which is called the *initial manifestation* or *lesion.* Later, this may assume one of several forms, and is often termed a hard, or indurated, or infecting chancre. The initial lesion presents certain differences in appearance, according to its position, and according as it has or has not been irritated. Its chief characteristic is the presence of induration at its base; and the aspect of the sore is much affected by the degree in which this hardness is developed. Sometimes the lesion is observed as a hard desquamating papule; sometimes as a prominent ulcer, having a hard well-defined base and thickened adherent margins (the so-called *Hunterian chancre*); but most commonly as an erosion or shallow ulcer, with an amount of induration which varies much in different cases, and which is not always easily appreciable unless care be taken. Sometimes the induration develops in a thin layer, like a piece of parchment, or even paper; hence the term 'parchment sore' often applied to this form of the initial lesion. In rare instances, especially in women, induration appears to be absent altogether. The secretion is thin, scanty, non-purulent; and though not readily inoculable on the bearer, it has nevertheless been successfully inoculated in certain cases during the primary stage. The syphilitic primary sore is usually *single*, contrasting strongly in this respect with the local venereal sore, in which multiplicity is the rule. The sore is indolent and mostly painless, and tends to disappear spontaneously.

The *seat* of the initial lesion is most frequently the genital organs, but, as has already been stated, absorption of the poison may occur in any situation where a breach of surface exists. Consequently the initial lesion may be found on any part of the body, as about the lips or mouth in children, on the breast in nurses, or on the hand or finger in the case of doctors and midwives.

If, as frequently happens in practice, irritating matter of any kind have been inoculated as well as the syphilitic poison, the course of events will vary according to the nature of the irritant. For example, if the pus of the local chancre have also been absorbed, the incubation period of syphilis will be occupied by the course of the suppurating sore, which may or may not have healed at the time the change peculiar to syphilis occurs. If the sore be still present, induration will develop, and the lesion will for a time assume the characters of both kinds of sore; but if it have healed, the cicatrix will harden and eventually assume more or less closely the appearance of one or other of the forms of initial lesion which have just been mentioned.

The initial lesion in rare instances may disappear in a few days, but its duration usually varies from two or three weeks to several months, according to its size and the influence of treatment. It sometimes breaks out again after cicatrisation; and induration may reappear, even repeatedly, without fresh contagion. If the sore, from irritation of any kind, be made to suppurate, the secretion may become freely inoculable on the bearer. When the chancrous and syphilitic poisons have both been inoculated, the resulting lesion has been termed by Rollet a 'mixed chancre.'

Glandular enlargement. — On whatever part of the body the initial lesion may be situated, the nearest lymphatic gland or glands become perceptibly enlarged in from seven to fourteen days after its appearance. When the glands themselves are multiple, the whole group is usually affected; but the gland most directly connected with the point of contagion enlarges first, and often attains a greater size than the others. In the absence of inflammation of the surrounding parts, each gland can be felt as a separate distinct indolent swelling, usually about the size of a marble, the cellular tissue and skin remaining free. At this time the enlargement commonly remains limited to the nearest group, but later is sometimes general. When the genital region is the seat of the initial lesion the glands of both groins are in most cases enlarged, though often to an unequal extent. Suppuration of the glands probably never occurs unless there be some source of irritation in addition to the syphilitic poison; the abscess in such cases is of a simple nature, unless the local chancre be present as well, and absorption of chancrous pus take place (*see* BUBO). Besides the glands, the *lymphatic vessels* leading to them—those of the penis, for example—can sometimes be felt as hard cords, freely movable beneath the skin. These cords have been found in certain cases to contain thickened blood-vessels.

2. **Secondary Syphilis.**—After the development of the initial manifestation, with its accompanying adenopathy, another interval occurs before further signs appear. This is sometimes called the *second incubation*, to distinguish it from that which intervenes between contagion and the appearance of the initial lesion. This second period of quiescence, counting from the appearance of the initial lesion to the appearance of the general eruption, is usually about six weeks. Thus, as a general rule, it may be stated that, in the absence of specific treatment, the rash appears from sixty to seventy days after contagion; from forty to fifty after the initial lesion; and from thirty to forty after enlargement of the proximate lymphatic glands.

During the earlier part of this period the patient commonly does not feel ill; but towards its close, and shortly before the appearance of the eruption, some patients, especially women, if they be not already under the influence of mercury, develop certain symptoms of constitutional derangement which have received the name of *prodromata.* Thus the patient may become pale and anæmic, and may suffer from shortness of breath and lassitude. In addition, headache, loss of appetite, malaise, pains in the limbs and back, rise of temperature, and other symptoms known under the name of 'syphilitic fever,' may be present. During this period also, as was first pointed out by Ricord and Grassi, whose conclusions have since been confirmed by others, the proportion of red blood-corpuscles is diminished. The prodromata are usually mild in degree, but occasionally they are severe. Thus, headache may be agonising, and in rare instances the amount of constitutional disturbance is so great that the onset of one of the acute fevers may be suspected.

Cutaneous system.—At the end of this second interval of quiescence, then, and having been preceded or not by some of the symptoms just mentioned, the first eruption appears. This, in the vast majority of cases, takes the form of roseola, consisting of rosy red spots, varying in size from a hempseed to a shilling, fading on pressure at first, but afterwards becoming dull red or brownish, and finally disappearing altogether, sometimes with slight desquamation of the cuticle. The spots usually appear first about the flanks and abdomen. The face and hands generally escape. The extent and duration of roseola vary much in different persons. It may be limited to a few faint spots on the anterior surface of the trunk, or the whole body may be covered with the rash, in which case it often resembles that of measles. Roseola may appear suddenly and disappear quickly; or it may last for several weeks, and indeed occasionally for months, if untreated. It sometimes recurs, but in that case is usually, though not invariably, limited to a few blotches or rings on the forehead, trunk, or limbs.

As the macular eruption fades, papules not uncommonly appear, so that a maculopapular eruption is often seen in early syphilis. The papules are raised, bright red at first, but later often assume the so-called 'coppery' hue, which, however, is much more like that of raw ham. Finally, the cuticle desquamates, leaving a silvery border or 'collarette' round the base of the papule. The papules are very liable to relapse, and to become scaly. When they fade, a brown stain is often left, which gradually disappears without leaving any scar. At this time also crusts are frequently present on the scalp among the hair, which itself becomes dry and withered, and at a later period often falls out, either generally or in patches. Syphilitic alopecia is in most cases limited to a temporary general thinning of the hair of the head, but all the hairy regions of the body may suffer. The nails also are liable to be attacked in several ways. *See* Nails, Diseases of.

Though the macular and papular syphilides are by far the most frequent forms of early rash, vesicular, pustular, rupial, and ulcerating eruptions sometimes appear during the secondary stage, the last two being most common in patients of bad constitution.

The earlier eruptions are usually superficial, and widely spread. Except perhaps in the case of the earliest rash, the papule forms the base of the spots. Irritation and itching are usually absent. The eruption has certain favourite seats, namely, the anterior and lateral surface of the trunk, the flexor surface of the limbs, the border of the hairy scalp. Several forms of eruption are often present at the same time; most commonly maculæ and papules, but sometimes papules and vesicles or pustules. They all tend to disappear spontaneously, and, except the pustular form, without leaving any scar.

Pigmentary changes in the skin are common in syphilis. Temporary excess of pigment may follow any syphilide, and this again may be followed by its loss, so that sometimes yellow or brown stains are seen, and sometimes white spots. A much rarer change, which differs from those just mentioned in that it does not follow another lesion on the same site, is that known as the *pigmentary syphilide.* It consists of irregular brownish patches situated chiefly about the sides of the neck, and observed mostly in women. Opinions are divided as to whether this is an essentially syphilitic affection or not. It lasts a long time, and is but little affected by antisyphilitic remedies.

Mucous membrane.—Besides the affections of the skin, lesions of the mucous membrane, particularly that of the mouth and throat, are nearly always present during the secondary stage of syphilis. Erythema, excoriations, or shallow ulcers are very common about the fauces and tonsils, as well as on the buccal surface and tongue, during the early portion of this stage; and the nasal and laryngeal mucous membrane is also liable to be similarly affected. Equally common, though usually somewhat later, are mucous patches or tubercles — condylomata (*see* Mucous Patch). They may occur on any moist surface, but are most frequently seen about the mouth, genital organs, and anus. The initial lesion also sometimes assumes the appearance of a mucous patch or tubercle.

These affections of the skin and mucous surfaces are often accompanied by more or less deterioration of the general health, with pallor, lassitude, and loss of weight. Aching in the muscles, bones, or joints (osteocopic pains), and sometimes periosteal swellings or synovial effusions, also occur, as well as more or less general enlargement of remote lymphatic glands, particularly those of the neck and beneath the jaw; but the axillary, epitrochlear, and indeed all the glands within reach, may be enlarged. Iritis is also liable to come on about this time, and, later, choroiditis. Sometimes, but more rarely, affections of the auditory apparatus are present. *See* EYE, AND ITS APPENDAGES, Diseases of; and EAR, Diseases of.

Enlargement of the epididymis, chiefly its head, is another, though rare, phenomenon in secondary syphilis. Temporary albuminuria and jaundice also sometimes occur during this stage.

The number, extent, and severity of the secondary manifestations vary greatly in different persons. In some cases roseola and slight redness and excoriation of the throat are the only signs that appear. In other instances roseola is succeeded by papular and scaly syphilides, and by obstinately recurring lesions of the mouth, throat, genital organs, or other parts of the body.

After the lapse of a period which varies usually from six to eighteen months, the secondary stage comes to an end, and in most cases the disease troubles the patient no longer. But supposing this not to be the case, there may be an interval of months or years during which no symptoms appear. Sometimes, however, symptoms continue to develop from time to time, which partake of the characters of both the secondary and tertiary stages, and which gradually merge into the latter without any strict line of demarcation between the two. Examples of these intermediate signs are thickened scaly patches on the skin, which often take a circular or serpiginous form, and sometimes ulcerate; obstinate eruptions of the soles and palms (the so-called plantar and palmar 'psoriasis'); ulcers and induration of the tongue; periosteal swellings; orchitis; and affections of the choroid and retina.

3. Tertiary Syphilis.—While the secondary stage of syphilis is mainly characterised by the occurrence of superficial lesions, more or less widely spread over the surface, and tending to spontaneous disappearance; the main features of tertiary affections, on the other hand, are that they usually attack only a limited area, that they have a tendency to extend and to cause destruction of tissue with consequent contraction and scarring, and that they do not tend to spontaneous recovery.

The lesions classed as tertiary are due to invasion of some part of the body by the granulomatous or gummy growth which has been already described. The tertiary period, also, is often attended by severe cachexia, with a peculiar pallor of the skin.

The syphilitic growth may assume a diffused or a circumscribed form; but in either case, unless checked by treatment, degeneration is usually rapid, leading to obstinate ulceration when the superficial structures are attacked, and to the production of tough contractile fibrous tissue when the viscera are the seat of the new-formation. Of the internal organs those belonging to the nervous system are most frequently affected.

When the gummy growth attacks the skin or mucous membrane in a diffused form, it produces hard, flat plaques of varying extent. The skin after a time becomes purplish-red and adherent, and finally breaks down at several points; an ulcer is left, which sometimes creeps over the surface (serpiginous ulceration), healing in the middle and extending at the margins, until a considerable amount of tissue is destroyed. When this diffused infiltration occurs in the pharynx, air-passages, or rectum, the disease is very obstinate, unless actively treated at an early stage, and the subsequent contraction may produce incurable and fatal stricture in any of those situations.

When the circumscribed form develops in the skin itself, it is often called a *syphilitic tubercle*. Gummata in the cellular tissue, when discovered early, appear as small hard nodules, movable beneath the skin; but after a time they enlarge, soften, and become adherent to the discoloured integument, which finally gives way, exposing a mass of yellowish-white material, which is gradually cast off in the form of *débris*, and thin ill-formed pus. The cavity then heals by granulation, leaving a depressed scar.

Irritation or injury seems often to determine the appearance of both the earlier and later syphilitic lesions; for example, the effects of smoking and broken teeth in the case of the throat and tongue, and a blow or squeeze in the case of the bones and testes.

The syphilitic affections of the other tissues, and of the various organs of the body, will be found described along with the other diseases of the several parts under their proper headings. *See* BRAIN, Syphilitic Disease of; BONE, Diseases of; LIVER, Syphilitic Disease of; and TESTES, Diseases of.

Malignant Syphilis.—It has already been mentioned that the division of syphilis into a secondary and a tertiary stage is to a great extent artificial; indeed, it is sometimes impossible to say under which title certain lesions ought to be classed. There are again cases, fortunately not common, to which the term malignant or galloping syphilis has been applied, in which the disease from the first pursues a rapid, destructive, and sometimes uncontrollable course. Skin-eruptions, which partake of the secondary stage in their widespread character, and of the tertiary in their tendency to ulcerate—rupia, for example—appear early, even while the initial lesion is still present. Deep ulcers form also in the mucous membrane, and the gummy growth may develop in the internal organs, and cause death, or the patient may die worn out by exhaustion, or from some intercurrent inflammation.

Inherited Syphilis.—Syphilis is a very frequent cause of *abortion*, especially if the parental infection be of recent date, or treatment have been neglected. If the child be carried the full term, it may be born dead, with or without signs of syphilis; most commonly, however, if the child be born alive, it does not show any signs of the disease at birth.

In inherited syphilis the initial manifestation is of course absent, and the disease appears to begin at the secondary stage. With this exception, the symptoms of the inherited are in their main features similar to those of the acquired disease, allowance being made for the difference between the actively growing tissues of the child and the fully developed organs of the adult. There are, however, two points that deserve notice. The first is the frequency with which the nasal mucous membrane is attacked, giving rise to one of the earliest and most characteristic symptoms, namely, snuffling. If the inflammation extend to the deeper structures, flattening or other deformity of the nose may follow. The second peculiarity is a tendency, much more marked in inherited than in acquired syphilis, to mingling of secondary and tertiary symptoms. Lesions of the bones and viscera, for instance, may occur, not only with the earlier skin eruptions, but even during intra-uterine life. These changes have been particularly described by Wegner, Parrot, R. W. Taylor, Barlow, Lees, and others. The bones most liable to be attacked are those of the cranial vault, and the long bones of the extremities. *See* BONE, Diseases of; and SKULL, Diseases of.

Supposing the child to have been born alive, it usually shows no evidence of disease for a period ranging between two and six weeks, rarely longer, after birth. It then, as a rule, gradually loses its healthy appearance, begins to snuffle, becomes fretful, and wastes rapidly. The child's skin assumes a dull dirty colour, and, though loose, dry, and wrinkled, is very brittle and easily breaks round the mouth and nose into chaps and fissures, the scars of which often form a characteristic sign in after-life, if the child survive. Macular, papular, vesicular, or pustular rashes, resembling those seen in the adult, also appear; and mucous patches are nearly always present, sooner or later, about the orifices of the body. Affections of the hair, the nails, the testes, and the viscera, similar to those of acquired syphilis, are also found in young children. Pemphigus is seen only in severe cases; it appears very early, and is frequently fatal. It is important to remember that the earlier lesions of inherited syphilis are just as contagious as those of the acquired form of the disease.

In later life, inherited syphilis may manifest itself by a number of symptoms which were formerly ascribed to scrofula. The forehead is prominent, and the bridge of the nose sunken. The growth is checked, the individual being stunted, weakly, ill-nourished, and of low vitality. The skin is soft and pallid, and perhaps ulcerated, or scarred by previous ulceration. The permanent teeth, especially the central upper incisors, as was first pointed out by Mr. Hutchinson, may be dwarfed, narrowed towards the cutting edge, and notched at the centre of the free border (*see* TEETH, Diseases of). The cornea is liable to a form of diffused inflammation (interstitial keratitis), leading to opacity and more or less impairment of vision; the iris and the deeper structures are also liable to be invaded; and deafness is sometimes present. These affections of the eye and ear are, according to Mr. Hutchinson, much more common in girls than in boys (*see* EYE, AND ITS APPENDAGES, Diseases of; and EAR, Diseases of). The bones of the palate and nose may be diseased; and nodes may appear in various situations; as well as a form of chronic synovitis, most frequently affecting the knee-joints. The fingers and toes also, and, more rarely, the metacarpal and metatarsal bones, may become enlarged. This form of dactylitis is most common in early life; but it has been observed after puberty, as well as in connexion with acquired syphilis. The soft palate and pharynx may be the seat of ulceration, which sometimes becomes phagedænic. The deeper tissues and the viscera are also liable to be attacked by processes similar to those which occur in the acquired disease, giving rise to a variety of symptoms, and sometimes leading to a fatal issue. Some authors (Mr. Hutchinson and M. Fournier, for example) believe that early life may be passed without symptoms, and that these later affections may constitute the first signs of inherited taint.

COURSE, DURATION, AND TERMINATIONS.—The course of syphilis varies very much, according to the individual, and according to the treatment adopted. In the majority of cases the disease runs its course within a year and a half or two years; but in certain rare cases it appears to end with the first eruption; sometimes, perhaps, even earlier than this. When tertiary symptoms ensue, the commonest period for their appearance is probably from three to five years after contagion; but they may be delayed for ten or twenty years, or even longer. On the other hand, as has been already stated, the secondary may run on into the tertiary stage without any appreciable interval. When tertiary symptoms have once appeared, the duration of the disease is uncertain, depending greatly on the habits and constitution of the patient, and on the effects of treatment. In some cases the patient continues to suffer throughout his life.

The usual termination of syphilis is in recovery, and this in many cases without treatment, if the patient suffer only from the more superficial forms of disease. In syphilitic disease of the viscera, unless it be recognised and treated, the termination is frequently fatal.

In *inherited syphilis*, if the child be born with signs of syphilis it usually dies; but when it remains healthy for some weeks after birth, the disease mostly ends in recovery within a year, provided proper treatment be carried out. In later childhood, however, or in adolescence, even up to the thirtieth year according to Mr. Hutchinson, further symptoms may develop; in which case the duration and termination will depend greatly upon their due recognition and appropriate treatment. When the disease is neglected, death is a frequent termination, especially among the ill-fed children of the poor.

Besides what, for want of knowledge, we call idiosyncrasy, the course and duration of syphilis are also influenced by many other circumstances—for example, climate, age, pregnancy, and the hygienic surroundings of the patient.

The greater or less severity of the disease, or the stage at which it may have arrived in the person from whom it is contracted, does not appear to have any appreciable influence on the course of acquired syphilis.

COMPLICATIONS.—*Phagedæna* is an occasional complication of the initial lesion, but more frequently of the later ulcerating syphilides. The *local chancre* is another complication, giving rise to what has been termed the 'mixed chancre.' *Erysipelas* sometimes attacks syphilitic patients, and is said to act beneficially in causing the disappearance of certain obstinate eruptions. This influence, however, is only seen in some chronic cases when the patient is otherwise in fair health. If erysipelas attack a cachectic person, with rapidly spreading lesions, the complication is a serious one, and may prove fatal. In *scrofulous* and *tuberculous* patients syphilis is often obstinate and severe. The skin-affections in such persons are prone to ulcerate, and syphilis seems in some cases to rouse the constitutional disease into activity. The *gouty* diathesis also influences the course of syphilis. The skin-eruptions often assume the scaly form, and resist treatment obstinately. *Bright's disease* is a serious complication. Patients whose kidneys are diseased are liable to suffer severely, both as regards the superficial tissues and the internal organs. *Alcoholism* is detrimental in two ways: first, by its injurious influence on the system generally; secondly, by preventing the proper action of specific remedies.

DIAGNOSIS.—In the diagnosis of syphilis much will depend on the stage at which the disease has arrived when the patient comes under observation. Before the incubation-period has come to an end the diagnosis will of course be impossible; but when the initial manifestation with its accompanying glandular enlargement has appeared, there is usually no difficulty, unless some local complication be present. The initial lesion is distinguished by its indurated base, the indolent superficial character of the ulceration when that is present, the thin serous discharge, and the indolent painless enlargement of the nearest group of lymphatic glands. The points of difference between the initial lesion of syphilis and the local chancre are considered elsewhere. *See* VENEREAL SORE.

The diagnosis of the early rashes does not, as a rule, present much difficulty, if the general characters already mentioned be attended to. In some cases, however, when pyrexia and general constitutional disturbance precede the outbreak of the eruption, the symptoms may be mistaken for those of some other disease. Syphilitic roseola has been mistaken for measles or scarlatina, and a vesicular syphilide for small-pox. The various forms of drug-eruption, especially that due to copaiba, should also be borne in mind. In doubtful cases, careful attention to the temperature, and the condition of the tongue, throat, and air-passages, together with the presence or absence of other signs of syphilis, will usually decide the question in a few days. The colour of a syphilide or scar, no matter how coppery it may be, is by itself of little value from a diagnostic point of view.

It is, however, at a later stage—perhaps many years after contagion, and long after the disappearance of outward signs of the disease—that the diagnosis presents most difficulty to the physician. For example, a patient comes with obscure symptoms, pointing to some lesion of the nervous system, lungs, liver, or other viscus. In such cases the skin and mucous membrane, particularly that of the mouth and throat, should be carefully inspected, and the bones and testes examined for irregularity or swelling. The eyes may afford important aid, by the detection of iritic adhesions or changes in the deeper structures. The presence of local paralyses, especially of the ocular muscles, is a valuable diagnostic sign. The absence of signs or characters distinctive of other diseases—cancer or tuberculosis, for example—is often also of value in doubtful cases.

When no conclusive information can be gained from any of these sources, the history becomes of the greatest importance. A venereal sore with lumps in the groins, and followed by a rash on the skin, sore throat or tongue, loss of hair, pains in the bones worse at night, and bad eyes, are some of the points that should be inquired into, and in women the occurrence of abortion or of still-birth.

In investigating the history of a supposed syphilitic person, it should be borne in mind that syphilis is not necessarily a venereal disease, and that consequently the initial lesion may have been far away from the genital organs; also that the early manifestations, particularly in women, may be so slight and so evanescent as to escape observation. Again, some may have forgotten that they have suffered from earlier signs; and others who do remember, obstinately conceal the fact. However this may be, the practitioner frequently fails to elicit any clear history of earlier manifestations in those who suffer from visceral syphilis. Sometimes also, for various reasons, the history cannot be inquired into. If neither the symptoms present at the time, nor inspection of the patient's body, nor the method of exclusion, nor the history of the case, separately or combined, suffice to render the diagnosis clear, specific remedies should be administered, and their effect awaited before an opinion is given. But it is well to be cautious in drawing conclusions from such evidence. The failure of specifics, in an affection of the nervous system for instance, does not prove that the case is not syphilitic, for they may not have been given early enough to check the disease. Again, improvement may occur under mercury or iodides in cases where there is no syphilis.

In the diagnosis of *inherited syphilis* at an early stage, snuffling and coryza, when well marked, are of much importance. Radiating cracks around the mouth and nostrils are also valuable signs. Besides the eruption on the skin, especially that of the buttocks and soles of the feet, mucous patches should be looked for about the mouth, anus, and genital organs. Pemphigus of the palms or soles is nearly always syphilitic, but it is rare. Enlargement of the spleen is a valuable corroborative sign. The bones of the skull and limbs should always be examined for osteophytes or epiphysial enlargement. It must be remembered also that, though pallor and wasting are common, a syphilitic child who suffers but slightly may retain a healthy appearance throughout.

In later childhood and adolescence the most valuable diagnostic signs are the low stature and puny development; the dull, pasty complexion; radiating scars about the mouth; the prominent forehead; the broad and sunken bridge of the nose; signs of present or past mischief in the cornea, iris, or choroid; the dwarfed and notched median upper incisors; deafness without otorrhœa; nodes on the bones; unhealthy ulceration, often closely resembling lupus, or its scars, especially of the face or throat. Here, again, if no conclusive signs be present, the history becomes most important, both of the patient himself and of his immediate relations, and here also the diagnosis has occasionally to be postponed until antisyphilitic remedies have been administered. Lastly, it is too often forgotten that syphilis in children is not necessarily inherited, but that it may have been acquired by suckling or in some other way.

Prognosis.—This, in the great majority of cases, is favourable, if the patient be otherwise in good health, of temperate habits, and especially if his disease be properly treated at an early period. The effect of other constitutional diseases has already been indicated among the complications of syphilis. Probably nothing tends more to prolong and aggravate the course of syphilis than habits of drinking. In persons given to alcohol, therefore, the prognosis should always be guarded.

An interesting question, and one on which further information is needed, is whether any trustworthy data as regards prognosis can be gained from the character of the early manifestations. Neither the length of incubation, nor the amount of induration or ulceration of the initial lesion, has been shown to afford any trustworthy evidence as regards prognosis. Early *general* glandular enlargement is often an unfavourable sign. Persons thus affected become anæmic, and consequently more liable to grave affections. As regards the early syphilides, it may be mentioned that the ordinary general macular and papular eruptions appear to be less common precursors of late visceral affections than early rashes that are ill-marked and scanty. Obstinate, frequently recurring lesions of the skin and mucous membrane also are rarely associated with visceral disease. In connexion with this may be mentioned the frequent failure of the physician to elicit any history of early symptoms in those who suffer at a later period from grave visceral affections, especially from syphilis of the nervous system.

In the cases of malignant or galloping syphilis, in which ulcerating and rapidly spreading lesions attack the skin and mucous membranes, and are associated with a tendency to phagedæna and great prostration at an early period after infection, the prognosis should be guarded; the patient may die worn out by the pain and profuse discharge of the superficial lesions, or of some acute affection. In syphilitic disease of any of the internal organs, the prognosis will depend greatly on its early recognition and treatment.

One of the most important points to be considered in prognosis is the way in which the patient has been treated. For, although we do not yet know any certain sign—save re-infection—which proves that syphilis has come to an end, it may with much confidence be stated that if mercurial treatment have been begun at an early period, and continued a sufficient length of time, and if the patient be constitutionally robust and of temperate habits, the chances are very greatly in favour of complete subsidence of the disease within two years after contagion.

Much of what has been said as to the prognosis of acquired syphilis applies also to the inherited form of the disease. A child in whom symptoms do not appear until several weeks after birth, who is well cared for, properly fed, and who receives proper medical treatment, will probably recover; one who is ill-fed and neglected will most probably die. Indeed, among the children of the poor, syphilis is one of the most fatal diseases of infantile life.

TREATMENT. — 1. **Preventive Treatment.**—At the present time there are unfortunately no State regulations to check the spreading of venereal diseases in this country.

Among individuals the strict daily observance of cleanliness, too often neglected by both sexes, constitutes the best protection against disease, and by preserving the epithelial surface in a sound and healthy condition would of itself, if generally practised, do much towards reducing the prevalence of syphilis.

There is no trustworthy evidence that syphilis can be cut short by removal or destruction of the initial lesion.

Every person who contracts syphilis should be warned of the danger of communicating it to others. Sexual intercourse should be prohibited while the disease remains active. This direction should never be omitted, as many patients are unaware that they are liable to communicate the disease after the initial manifestation has healed.

The contagious nature of the lesions of the mouth and throat should also be pointed out, and the consequent risk of contagion by kissing, or by the use of drinking-vessels, pipes, towels, or other articles in common with other persons.

The question of *marriage* in relation to syphilis is one of great importance, and it is the duty of the practitioner to prevent the contamination of a healthy person, or the procreation of syphilitic children, whenever it is in his power to do so. No person who shows signs of active syphilis should be permitted to marry, however long a time may have elapsed since contagion; for although communication of the disease is probably rare after two years have gone by, it may take place after ten years, or even longer in neglected cases. It has already been stated that syphilis usually ceases to be active within two years after contagion; but this is not always so. After the last symptoms have disappeared, there should be an interval of at least a year before marriage takes place; but the period between contagion and marriage should never be less than three years. If the treatment during the early stages have not been systematic and prolonged, it will often be advisable to subject the candidate for marriage to a course of mercury for about three months, and after this to keep him under observation for a year before the marriage takes place.

The spread of syphilis from children to nurses, and *vice versâ*, must also be guarded against, and the practitioner should never allow a syphilitic child to be entrusted to a healthy wet-nurse, nor a syphilitic woman to suckle a healthy child.

2. **Curative Treatment.** — The treatment of syphilis may be divided into (*a*) *general*; (*b*) *specific*; and (*c*) *local treatment*.

(*a*) *General treatment.*—Syphilis is essentially a debilitating disease; hence it is most important that the general health of the patient should be supported by nourishing diet, good air, warm clothing, extreme moderation as regards alcoholic liquors, cleanliness, cheerful society, and moderate exercise in the open air. In most cases the patient may follow his usual employment, unless it involve prolonged exposure to damp and cold. The skin should be stimulated to act freely, by the frequent use of soap and water, and an occasional vapour or Turkish bath if thought desirable. Some woollen material should be worn next the skin, and chills avoided as much as possible. Smoking in moderation may be allowed, as long as the mouth and throat remain free; but when syphilitic lesions are present, it should always be discontinued, and if they show a tendency to recur smoking should be abandoned altogether. Regular action of the bowels is also important.

(*b*) *Specific treatment.*—Besides attention to the general health of the patient on ordinary principles, the administration of certain drugs which are known to have specific influence over syphilis should never be omitted, however mild the earlier manifestations of the disease may be. For although syphilis tends in most cases to subside spontaneously, it does not do so in all; and in the present state of our knowledge we have no certain means of distinguishing at the onset the cases which will get well, from those in which tertiary symptoms will follow. There is also much evidence to show that, when proper and sufficient treatment has been carried out in the earlier period, the danger of later manifestations is very much less than in cases that have been untreated, or treated only by ordinary means. Again, in some of the gravest cases of visceral syphilis the history of early signs is defective, suggesting that they have been so slight as to have been overlooked, and consequently untreated.

The special drugs now almost exclusively used in the treatment of syphilis are *mercury*, and the various salts of *iodine*. Probably the former only can be looked on as a permanent remedy. The iodides are of great value in some of the earlier as well as in most of the later manifestations of syphilis; but the effects are not always lasting, and therefore they cannot be trusted to alone.

Much of the prejudice against the use of *mercury* has arisen from the fact that in former times its administration was carried to a poisonous extent. It is now known that salivation is hardly ever necessary, and that if the drug be properly administered in suitable doses, it acts as a tonic, syphilitic patients rapidly improving in health and gaining weight under its use.

As soon as induration at the site of contagion, and multiple indolent enlargement of the proximate lymphatic glands, make the diagnosis of syphilis certain, mercury should be given. For all the symptoms of the secondary stage, also, mercury is appropriate. And in the later stages it should be used in conjunction with iodides, as well as in cases where the iodides fail to relieve. Mercury may be given to almost all persons when its use is indicated, but its effect must be carefully watched if the patient be in feeble health, or the subject of disease of the kidneys.

Before a mercurial course is begun the mouth should, as far as possible, be put in a healthy condition. Unsound teeth should be stopped or removed, and tartar got rid of. If the gums are spongy, an alum mouth-wash should be used frequently. The patient should also be warned that fruit and green vegetables may cause diarrhœa during a course of mercury. Milk usually agrees well, and may be taken freely.

When mercury is taken in syphilis, the patient usually improves rapidly. If a rash be present it soon begins to fade, and ulcerated surfaces begin to heal. All the necessary results are usually attained without any, or with only the slightest, visible effect on the gums.

Mercury should be given for at least a year after contagion. During this period it will be necessary to omit the drug from time to time, and perhaps to vary its form; but what should be the length of each course, and what the length of the intervals, are questions that must be decided according to the symptoms that appear, and according to the effects of mercury in each case. After the first year no general rules can be laid down. As long as there are signs of syphilis treatment must of course be carried out; but the particular drug to be chosen, its dose, and the length of time it should be continued, ought to depend on what has been learned beforehand about the patient and his malady, as well as on the treatment he has already undergone.

Mercury may be introduced into the system in various ways—by the stomach, rectum, vagina, skin, or subcutaneous tissues; but its action is essentially the same by whatever channel it is administered.

In the majority of cases mercury may be most conveniently given by the mouth. In early syphilis blue pill usually fulfils all the requirements of the case; and the writer has found this more generally useful and less likely to disagree than grey powder. If no urgent symptoms be present, a grain of one or other of these preparations may be given, with a little extract of gentian, three or four times a day, immediately after meals. Quinine or reduced iron may be added, if thought desirable, but opium is usually unnecessary. In such small doses mercury rarely causes either stomatitis or purging, but the possibility of both should always be mentioned to the patient. If, however, a rapid effect be desired—in iritis, for example—2 or 3 grains of blue pill, with $\frac{1}{4}$ or $\frac{1}{3}$ grain of opium, may be given three or four times a day, the patient being kept indoors, until the requisite effect is produced, after which the drug should be given less frequently, or be reduced in quantity. If a mild degree of salivation be inadvertently set up, the mercury should be discontinued for a time, a purge administered, and the mouth washed out frequently with an alum or chlorate of potassium gargle. *See* MERCURY, Diseases Arising from; and SALIVATION.

The green iodide of mercury is an active salt, which is largely used on the Continent, especially in France, but it is more liable to decomposition and to cause irritation than the forms just mentioned. It may be given in doses of $\frac{1}{4}$ to 1 grain, with a little opium, twice or thrice a day.

The perchloride of mercury is mostly given in the later and more chronic forms of syphilis, but in the early stages it is sometimes better borne than almost any other preparation. It may be prescribed in doses of $\frac{1}{16}$ to $\frac{1}{8}$ grain, either in a mixture with iodide of potassium or with perchloride of iron, or in a pill, according to circumstances. The red iodide is also useful, especially in cases of relapsing scaly syphilides.

When other preparations purge or otherwise disagree, the tannate of mercury in 1 or $1\frac{1}{2}$ grain doses sometimes answers well.

A mixture of sarsaparilla and aromatics with antimony or mercury, known as *Zittmann's decoction*, is sometimes useful in tertiary syphilis.

Inunction is very effective, but it is troublesome to the patient; hence he often neglects to carry it out properly. It may be employed whenever mercury is indicated, 20 to 60 grains of mercurial ointment being rubbed in every night, or every other night, as required. *See* INUNCTION.

The *mercurial vapour-bath* is beneficial in certain cases, especially those of widespread rash. *See* FUMIGATION.

Subcutaneous or rather *intra-muscular injection* is probably the quickest way of obtaining the effects of mercury, but it is more or less painful, and not altogether free from risk; hence it is only to be recommended when other means fail, or in very urgent cases. Nearly every known preparation of mercury, soluble and insoluble, has in turn been employed, but there is no general agreement as to which is the best. A solution containing 1 part of the red iodide with sufficient iodide of sodium to dissolve it in 64 parts of water answers well. Dose, 6 to 8 minims.

The salts of *iodine* are principally used in the treatment of tertiary syphilis; but it is a mistake to look upon them as adapted only for that stage. In the secondary period, and in cases where the lesions partake of the characters of both stages, the iodides may often be advantageously combined with mercury. Speaking generally, the writer believes that the iodides are indicated when there is evidence of a marked tendency to new-growth at any time after the primary stage. In cases where the symptoms have been controlled by iodine, mercury should, as a rule, be given to complete the cure.

Iodide of potassium is the salt most frequently used; but the iodides of sodium and of ammonium are also employed. The action of all is similar, but the sodium and ammonium salts appear to be less depressing. They may be given separately or combined. The dose of the iodides varies from 2 or 3 to 100 grains or even more. In ordinary circumstances it is best to begin with 3 or 4 grains, with a little carbonate of ammonium, three times a day, and to increase the dose if necessary. In urgent cases, such as those of naso-pharyngeal disease, in which deformity is threatened, as well as in some cases of visceral disease, particularly in syphilitic affections of the nervous system, from 10 to 20 grains may be given at first, and the dose rapidly increased until some effect is produced. In such cases, also, it will often be prudent to carry out inunction, or the subcutaneous injection of mercury, at the same time. The iodides should be given well diluted; and any of the bitter infusions, or tartarated iron, may be added when their use is indicated. Milk is an excellent vehicle, especially in the case of children. Iodides may also be effectively administered *per rectum*.

Donovan's solution (Liquor arsenii et hydrargyri iodidi, B.P.) acts well in many of the later affections of the skin and mucous membranes. The dose is from 10 to 30 minims.

Iodoform is occasionally given internally in the later stages of syphilis; but it frequently causes gastric and intestinal irritation. The dose is about a grain, in the form of a pill.

The bromides of potassium, sodium, and ammonium are serviceable in certain cases of syphilitic affection of the nervous system. They may be given alone or with iodides, according to circumstances.

Besides the foregoing remedies, many others may be required in the treatment of syphilis. Iron and nux vomica or strychnine are drugs that are frequently of the greatest value, either in conjunction with specifics or with quinine. Cod-liver oil also is valuable in many cases. Sarsaparilla is sometimes beneficial in enabling the patient to bear large doses of iodide; it is also often useful during or after a prolonged course of specifics. Mineral acids and vegetable bitters are often of service during the intervals of specific treatment. Opium is sometimes necessary to prevent the purgative action of mercury, especially when large doses are taken, as well as to relieve pain in some of the affections produced by syphilis.

Certain bathing resorts which possess *sulphur* springs—Aix-la-Chapelle, for example—have become noted for the cure of syphilis; and there can be no doubt that great benefit is often derived from the course of treatment pursued at such places. The good results, however, are due rather to a combination of specific remedies and diaphoresis, with strict attention to diet and general hygiene, than to any special virtues of the waters themselves.

When syphilis is complicated with scrofula, gout, rheumatism, or other disease, the appropriate remedies should be given with those proper for syphilis, or temporarily substituted for them according to circumstances.

A certain number of persons are either unusually susceptible or unusually insusceptible to mercury or iodides in ordinary doses. Nearly all such cases, however, can be managed by making the dose small enough or large enough as the case may be, by combining tonics or sedatives with the specific, or by altering the mode of administration, together with strict attention to diet and the manner of living generally.

(*c*) *Local treatment.*—The initial lesion of syphilis usually requires only cleanliness, and the application of a little calomel powder or black wash. If the sore suppurate, it should be cleaned, dried, and dressed with finely powdered iodoform. Phagedæna must be treated by immersion, caustics, or the actual cautery, while the general health receives attention (*see* VENEREAL SORE). If the lymphatic glands become tender or inflamed, warm fomentations should be applied, and the patient kept lying down. If an abscess form, it must be treated according to the directions given in the article on BUBO, VENEREAL.

The early eruptions on the skin rarely require local treatment: oleate of mercury may be used for conspicuous spots. Erosions or fissures may be dressed with an ointment of calomel and vaseline, or with iodoform.

In the scaly affections of the palms and soles, an ointment of ammoniated mercury and oxide of zinc may be well rubbed in at bedtime, gloves being worn during the night. Mercurial plaster also is often a useful application. Mucous patches should be cleansed and dried several times daily, powdered with calomel and oxide of zinc, and covered with dry lint. If they are large and prominent, carbolic acid or acid nitrate of mercury may be applied. Cracks and ulcers about the nails should be dressed with red oxide of mercury ointment.

Ulcers or fissures, or mucous patches of the lips, tongue, mouth, and throat should be touched with carbolic acid, and an alum or borax wash used frequently, especially after eating. Other valuable applications are a mouth-wash of perchloride of mercury $\frac{1}{8}$ to $\frac{1}{4}$ grain to the ounce, or a stronger solution applied with a mop, and a solution of chromic acid, from 10 to 20 grains to the ounce of water. For the later ulcers internal treatment is of great importance.

Ulcers and chinks about the nostrils should be kept moist with red oxide of mercury and vaseline ointment. When necrosis of the nasal or palatal bones has occurred, a lotion of permanganate of potassium or chlorinated soda should be used with a syringe or as a coarse spray, and the fragments removed as soon as they become loose. The early affections of the larynx usually disappear without local treatment. In the later affections general treatment is most important, but tracheotomy may sometimes be required.

Ulcers about the anus require careful cleansing and the application of calomel or iodoform ointment. For ulceration within the rectum iodoform suppositories and astringent injections should be used. In stricture of the rectum careful dilatation by means of bougies may be tried. In extreme cases rectotomy, or even colotomy, may have to be performed.

As regards the bones, the pain produced by early nodes is relieved by painting with a solution of iodine. As a rule, nodes should not be opened. If necrosis take place, the dead bone should be removed as soon as it becomes loose.

In iritis, besides the prompt administration of mercury, a solution of sulphate of atropine (1 grain to 2 drachms) should be dropped into the eye every two hours till the pupil is well dilated. Afterwards a weaker solution may be used to keep up the effect. In interstitial keratitis also atropine should be used. Iridectomy is occasionally necessary. In choroiditis and retinitis leeching is sometimes useful when there is much pain, but constitutional treatment is more important.

In syphilitic orchitis a suspensory bandage should be worn, but other local treatment is usually unnecessary, unless a gumma break down and fungous protrusion occur, in which case support should be given by strapping. Syphilides of the female genital organs should be dressed with iodoform, and the application of strong carbolic acid is also often beneficial. If the cervix uteri be affected, vaginal injections will be needed as well.

Treatment of Inherited Syphilis.—*Preventive treatment.*—If a syphilitic man have a relapse after marriage with a healthy woman, he ought at once to desist from intercourse—indeed, from contact of every kind—and undergo thorough treatment. The wife also should be watched, that treatment may be begun as early as possible, if she have contracted the disease. A woman who has borne a syphilitic child should be treated with mercury whether she show signs herself or not.

Treatment of the child.—Mercurial treatment should always be adopted as soon as symptoms appear. Grey powder may be given in one-grain doses twice a day. Or a strip of flannel smeared with diluted mercurial ointment may be worn round the waist. The ointment should be renewed every night, and the skin cleansed every third day. Some preparation of iron and cod-liver oil are also often useful. Treatment should be continued for a few weeks after all symptoms have disappeared.

Iodide of potassium is most valuable in the later forms of disease. The rules for its employment, alone or with mercury, are the same as in acquired syphilis, but the dose must of course be adapted to the age of the patient.

The *local treatment* of the syphilitic affections of children is similar to that recommended for adults. When the nostrils are obstructed by inspissated mucus, they must be carefully cleansed with a borax and glycerine lotion by means of a camel's-hair brush, and sores dressed with diluted red oxide of mercury ointment.

The *general management* and *diet* of syphilitic children are most important. Whenever the mother can suckle her child, she should do so. If this be impossible, a wet-nurse who has already suffered from the disease is the best substitute. If neither be available, ass's, goat's, or cow's milk must be given. Extreme cleanliness and fresh air are essential. ARTHUR COOPER.

SYRINGOMYELIA (σύριγξ, a cavity; and μυελός, the marrow).—A name under which Ollivier grouped numerous cases in which cavities of different kinds were met with within the substance of the spinal cord. *See* SPINAL CORD, Special Diseases of, No. 21.

SYSTOLIC.—Of or belonging to the systole or contraction of the heart, and usually associated with the cardiac impulse or sounds, or with murmurs. *See* PHYSICAL EXAMINATION.

T

TABES (*tabes*, a consumption).—A term formerly employed to denote consumption or wasting of the body.

TABES DORSALIS.—Synon.: Locomotor Ataxy; Fr. *Ataxie Locomotrice*; Ger. *Graue Degeneration der Hinterstränge des Rückenmarks.*

Definition.—A disease of the spinal cord alone, or of the spinal cord and peripheral nerves; manifested, when considerable, by incoördination of movement, peculiar pains, defective sensibility, and loss of muscle-reflex action (myotatic irritability).

Ætiology.—Males suffer more frequently than females, the proportion being about ten to one. A neurotic heredity can occasionally be traced; seldom direct inheritance. Amongst individual causes one greatly exceeds the rest, namely, the influence of syphilis. When every allowance is made for accidental coincidence, it is found that in at least one-half the cases the coincidence must depend upon causal relationship, and it is probable that this is true of a considerably larger proportion. The interval between the primary manifestations of syphilis and the first symptoms of tabes varies from one to twenty years. It is rarely less than three years, although cases have occurred in which the first symptoms have actually occurred during the active stage of syphilis. But syphilis is not the only cause, and in a few cases (less than 10 per cent. of the whole) it can be excluded with confidence. The other causes operative are traumatism, exposure to cold and wet, and over-exertion. Alcoholic and sexual excess are also probable factors in its production; and it occurs sometimes as a sequel to certain acute diseases, such as acute rheumatism, typhoid fever, and diphtheria. Symptoms of tabes also occasionally precede other diseases of the spinal cord, such as myelitis, such sequence being especially common in syphilitic subjects. This constitutes the variety which is known as 'secondary tabes.'

Anatomical Characters.—In most cases the spinal cord presents changes visible to the naked eye. These consist in a grey translucent appearance of the posterior columns. The whole of these columns may be thus changed or only parts of them, the extent of the changes being usually proportional to the severity and duration of the disease. With the microscope this change, or 'sclerosis' as it is called, is found to consist in an overgrowth of the interstitial elements, and wasting at the expense of the nervous elements in the areas affected. In the most common conditions the sclerosis occupies the whole of the posterior columns in the lumbar region, and becomes gradually restricted to the postero-median columns higher up, having thus the character of an ascending degeneration. In rare cases of severe character and long duration the posterior columns are occupied by connective tissue throughout the whole vertical extent of the cord. In slight cases the sclerosis may be limited in the lumbar region to the posterior root zone. Sclerosis may also affect other areas of the cord. The fine fibres of the posterior root described by the authority whose name they bear, Lissauer's tract, are generally affected. The direct cerebellar and ascending antero-lateral tracts may also show sclerosis. In rare cases even the pyramidal tracts are affected. Often in old cases there is a slight general increase of the connective tissue throughout the cord.

Changes in the grey matter are difficult to discover in the milder cases. In more advanced cases some atrophy of the anterior cornual cells may be detected if there has been muscular wasting. The posterior vesicular column may show distinct degeneration, and this is said to be associated with sclerosis of the direct cerebellar tract. The grey commissure also may be atrophied, and the nerve cells and fibres in the posterior horn probably undergo changes which are difficult to detect.

The posterior nerve-roots are also frequently atrophied, and the degree of atrophy depends upon the severity of the affection. The histological changes extend as far as the ganglion. The peripheral nerves are altered, the change consisting in a wasting of fibres which commences in the white substance, and extends to the axis-cylinders. There may be an increase of interstitial tissue, but the change is essentially one in the nerve-fibres themselves. This degeneration is greatest in the terminal filaments, and rarely extends in any marked degree into the main trunks. The sensory elements are alone affected. The changes in these have been chiefly found in the nerves supplying the skin, but Déjérine has demonstrated the presence of similar conditions in the sensory nerves of muscle.

Symptoms.—The most common and characteristic symptom of tabes is the ataxy. This varies in degree in different cases, and may be entirely absent. Before the condition is sufficiently marked to cause the characteristic disorder in movement, it may render standing difficult, especially if the eyes are closed ('Romberg's symptom');

and a still slighter degree may be evidenced only by the startings of tendons in the uncovered feet in the effort to maintain the equilibrium. As the defect progresses, it gradually impairs the patient's ability to get about; and finally locomotion is rendered altogether impossible. As a rule, the affection of the lower limbs is earlier and much more severe, but the arms may be similarly affected. There is a difficulty in fine movements, such as buttoning the coat; the grasp is not sustained; and slow unintended movements may be present in the fingers, when these are kept in one posture by muscular effort, closely resembling those of athetosis. They cease when muscular effort is relinquished.

Among sensory symptoms the most obtrusive are the severe and distressing 'lightning pains.' These are present in the majority of cases, and are characterised by their sudden, acute, stabbing character. The attacks of these pains alternate with periods of entire freedom, varying in duration. Their onset often seems to be determined by the state of the atmosphere. In some cases they are never present, and even in cases in which they have been severe they may suddenly cease and never return. There are also frequently present dull aching pains and sensory paræsthesiæ, such as numbness, tingling, and feelings of 'needles and pins.' Another sensory symptom often complained of is a sense of constriction in some part of the trunk, usually round the waist—the so-called 'girdle sensation.' A similar sensation may be present in the leg or thigh, as if a band or garter were tied tightly round it. Sensory disturbance may also be manifested by impairment of cutaneous sensibility. This is most frequent in the legs and feet. The tactile sense alone may be impaired, or those for pain and for temperature may also suffer. The temperature sense may escape when sensibility to pain is much impaired. The converse rarely, if ever, occurs. Besides the impairment through delay in the transmission of painful sensations—as much as fifteen seconds, according to Eulenberg—there may be, as the result of one prick, rhythmical recurrence of sensation, quick or deliberate. Sometimes localisation is disordered, so that a prick on one leg is referred to the other, or a prick on one spot may be felt in several (*see* ALLOCHIRIA). Sensory loss may also be present in the muscles, so that their contraction or electrical stimulation may be unfelt, and the muscular sense may be so impaired that the position of the limbs is not known unless they are seen.

Reflex action is impaired in tabes. Cutaneous reflex action is usually impaired in proportion to the loss of cutaneous sensibility. But more important is the condition of the muscle-reflex action shown by the state of the knee-jerk, the loss of which, as Westphal first pointed out, is one of the earliest and most constant symptoms of tabes. It is very rare for the knee-jerk to be obtained in any case of true tabes. Its loss may precede for years the onset of ataxy.

There is a large group of ocular symptoms that must be mentioned in connexion with tabes. Of these, the most important is the loss of the reaction of the pupil to light, while it still continues to act with accommodation—the so-called Argyll-Robertson phenomenon. This condition is present in almost five-sixths of the cases of tabes. Often also the dilatation that occurs with painful stimulation of the neck ceases to be produced. The pupils may be very small, but not infrequently they are of normal size. Paralysis of different ocular muscles may also be present, with accompanying diplopia. The muscles supplied by the third nerve are most frequently affected. This paralysis may be transient—lasting a few days or weeks, or permanent. The former is most common in the early stage, the latter in the late stage of the disease. There may be a continued palsy of different nerves, suggesting a cerebral origin, and a condition of progressive ophthalmoplegia may be established. Other cranial nerves may be similarly affected.

Among the more serious and troublesome of the symptoms of tabes the various so-called 'crises' must be enumerated. These are named after the various viscera affected. Thus, the most common are the gastric crises, which are manifested by severe sickness and nausea, often associated with intense epigastric pain. To the severe attacks of dyspnœa, which are not uncommon, the name laryngeal crises has been given. These are associated with bilateral paralysis of the abductors of the vocal cords. There are also vesical, bronchial, and rectal crises, manifested by symptoms referable to the various viscera indicated.

The sphincters are usually deranged in their action. Retention of urine may be followed by incontinence. The latter at first is not infrequently the result of over-distension. When this is not the cause, incontinence is usually associated with cystitis. The trouble with the rectum is usually constipation, but in the later stages incontinence of fæces may also be present. The sexual functions are usually altered. In the early stage there may be increased sexual activity, associated with increase of the cutaneous reflex action, but when the cases come under observation the condition is usually one of impaired or abolished sexual power, though sometimes this is retained to a late stage.

Vaso-motor and trophic disturbances are both interesting and important. Among them may be enumerated local sweatings, disappearance of pigment from the skin and hair, ecchymoses, and altered growth of hair in connexion with attacks of pain. Changes in the epidermis of the sole may be present, and troublesome ulceration of the toes is not uncommon. The so-called perforating ulcer of the foot is almost confined to tabes. Changes in the teeth and nails also occur, leading to partial decay or total loss. Changes in the joints and bones occur, and have been carefully investigated by the late Dr. Charcot. The bones may become brittle, and so render the occurrence of spontaneous fractures easy; but the most important condition is the so-called 'Charcot joint.' This is due to wasting of the articular surfaces and heads of the bones. Accompanying it may be irregular outgrowth of bone, and it is often accompanied by an effusion within the joint and sometimes by œdema outside it. The larger joints are most commonly affected, but the fingers have been known to suffer.

Course and Terminations.—The course of the disease is extremely variable. There are usually three stages—the first one, in which the gait is not yet affected; the second, in which there is distinct incoördination; and a third, in which the ability to walk is lost. The first stage varies in duration from a few weeks or months to as long as twenty-five years; and if the patients are subjected to careful treatment there is no progressive tendency shown in probably so large a proportion as one-half the cases. Some even improve, so that a patient at one time unable to walk was able some years later to get about with a fair amount of ease. When optic atrophy is present, this and the loss of the knee-jerk may remain for many years the only symptoms.

The dangers of locomotor ataxy consist not so much in the rapid spread of degenerative processes in the nervous system, as in the occurrence of kidney conditions secondary to cystitis. Laryngeal crises also constitute an element of danger; and suddenly occurring trophic disturbances have been known to prove fatal. General paralysis of the insane is a not unusual complication, and it runs the usual course, as a rule, within the prescribed limit. Valvular heart-disease is also an occasional complication of the disease, and is probably the result of a syphilitic process. This also may lead to a fatal termination.

Pathology.—In discussing the pathology of this disease it must be recognised that in tabes the main incidence of the marked change is upon the afferent nervous system, and that it is almost certainly a primary degenerative disease of the nervous elements. The symmetry of the lesions suggests a blood-state as the cause, and the very frequent antecedence of syphilis, taken together with the condition of the peripheral nervous system, suggests a somewhat close analogy to forms of peripheral neuritis, which occur after acute specific diseases, and sometimes from alcohol and other causes. The long interval which elapses between the primary disease and its nervous sequela is only in proportion to the chronicity of the primary specific disease; and the general conditions of its occurrence suggest that its immediate cause is the presence of some poison in the blood not itself organismal, but more probably a product of the growth of organisms. This may be a chemical substance and not a living virus, though produced by such. Recent research has brought into prominence the important *rôle* played by such products in the generation of disease, and such a theory would furnish an explanation of the usual inefficiency of antisyphilitic treatment in tabes, to which reference will presently be made.

Diagnosis.—Tabes dorsalis may easily be confounded with alcoholic neuritis. In the latter, however, there is the tenderness along the nerve-trunks, and the sphincters and pupils are unaffected. The history of alcoholic excess will also help in the diagnosis. The latter, and improvement when the cause is withdrawn, are the chief distinctions from the form termed 'alcoholic pseudo-tabes,' which resembles locomotor ataxy very closely. The hereditary form of ataxy offers many points of resemblance to tabes, but is distinguished by the earlier age at which it occurs, and the absence of the usual pain and 'crises.' Diphtheritic paralysis also bears some resemblance, but the history of the onset will usually clear up the point. Other forms of paraplegia, such as ataxic paraplegia, are usually distinguished by the presence of the knee-jerk. Injury affecting the posterior columns, or a tumour pressing on them, may simulate tabes; and a tumour in the cerebellum, by giving rise to ataxy, may raise a question of diagnosis. The difficulty in such a case may be increased by the absence of the knee-jerk; but while this is the almost invariable rule in tabes dorsalis, it is unusual in cerebellar tumour. In the latter condition also the other symptoms of tumour will probably be present, or enough of them to decide the diagnosis.

Prognosis.—This must be based upon the considerations mentioned in the description of the course of the disease. Some cases are obstinately progressive, but this is not the rule as regards the majority. The prognosis is usually good as regards a fair duration of life, for the malady does not itself kill; and it should be borne in mind that many cases show no progressive tendency, and that some greatly improve. The optic nerve atrophy is usually progressive, but not invariably so; and the opinion expressed concerning any case must largely depend upon the ability and willingness of the patient to carry out necessary instructions and treatment.

Treatment.—Much can be done by treatment in tabes, at least to relieve, apparently even to considerably modify the course of the disease. The influence of rest and hygienic surroundings in doing so is very great. The avoidance of mental worry and fatigue is also a powerful factor in obtaining benefit. Exercise should be gentle, and should always stop short of fatigue. The avoidance of sexual excess is of the greatest importance. Indulgence may lead to the most disastrous consequences. Great care should be directed to the avoidance of dyspepsia and constipation, as an attack of either may excite lightning pains or a gastric crisis.

Much also may be done by drugs. The almost invariable inefficacy of antisyphilitic remedies finds an explanation in the view of the pathology already enunciated. Arsenic is probably the most generally useful of all drugs. Others that may be enumerated are nitrate of silver, ergot, Calabar bean, strychnine, and phosphorus. The writer has lately found chloride of aluminium very useful. Counter-irritation to the spine is undoubtedly beneficial in acute cases. The best way to apply it is by means of the mild actual cautery. Electricity has probably little if any influence even in mitigating the pain. Nerve-stretching and suspension, although recently fashionable, are probably valueless and fast passing out of use. It is fortunate that we now have in phenazone and acetanilide means almost invariably reliable for lessening the lightning pains of tabes. Exalgin and phenacetin are less generally efficacious, but may succeed in cases in which the others fail. Hypodermic injections of the hydrochlorate of cocaine are most useful for superficial pains with tenderness of the skin. These may also be relieved by the application of chloroform sprinkled on spongiopiline. Gastric crises may be treated by removing a possible exciting cause, such as an attack of dyspepsia or constipation. Simple food must be administered, and morphine by hypodermic injection if necessary. Laryngeal crises are usually relieved by nitroglycerine or nitrite of amyl. Rarely is tracheotomy necessary, but it is always a possibility. The condition of the bladder must be attended to most carefully. No hesitation should be felt in using the catheter as often or as early as is necessary, if the bladder is imperfectly emptied; and it should be washed out with a weak solution of boric acid if there is turbidity of the urine. The general hygienic conditions should of course be the best possible.

W. R. Gowers.

TABES MESENTERICA (*tabes*, a consumption; and *mesenterica*, mesenteric). An affection attended with marked wasting, and caused by tubercular or scrofulous disease of the mesenteric glands. *See* Mesenteric Glands, Diseases of.

TACHE (Fr.), a spot or patch.—The word is most frequently used in connexion with morbid conditions of the skin. *Tache cérébrale* is a term that was specially applied by Trousseau to a streak of hyperæmia, produced by drawing the nail over the skin (usually of the abdomen) in certain cases of cerebral meningitis. *See* Meninges, Cerebral, Inflammation of, Tubercular.

TACHYCARDIA (ταχύς, rapid; and καρδία, the heart).—A form of functional disturbance of the heart, characterised by greatly increased frequency. *See* Heart, Functional Disorders of.

TÆNIA. — Synon.: Tape-worm. — *See* Entozoa.

TANGIERS, in North Africa.—*See* Morocco.

TAPE-WORMS.—*See* Entozoa.

TAPPING.—A popular name for paracentesis. *See* Paracentesis.

TARANTISM (*tarantula*, a ground spider).—Synon.: Fr. *Tarentisme*; *Chorée Épidémique*; Ger. *Tarantismus.*

Definition.—An epidemic dancing mania, prevalent in Italy in the sixteenth and seventeenth centuries, originating in fear of the bite of the tarantula, as a remedy for which the dance was adopted. A full account of it will be found in Hecker's *Epidemics of the Middle Ages.*

History.—The Italian dancing mania commenced in Apulia, in the latter part of the fifteenth century, contemporaneously with the St. Vitus's dance in Germany. The ground spider had long been held in dread, as causing, by its bite, symptoms of nervous and physical prostration, which might end in death, or lifelong lassitude. At this period the fear of the frequently recurring epidemics of the Black Death, Eastern plague, and other diseases, caused widespread depression. The tarantula was dreaded throughout Italy, and the aspect of the insect is sufficient to explain the exaggerated opinions regarding it. An unperceived bite was a ready explanation of any symptoms of nervous prostration. The inspiriting influence of music and rhythmical motion was found to dispel, for a time, the depression, which was itself purely psychical in origin. The theory arose that by means of the motion the poison of the spider was distributed over the body, and expelled through the skin. The nervous excitement of the remedy proved, however, a greater evil than the supposed disease. The induced emotion outran control. The dancing became frantic, and was continued until the dancers fell senseless from exhaustion, with the result that, on regaining strength, they were for a time free from the depression. The dancing mania spread by 'moral contagion,' and large numbers of persons, young and old, male and female, became affected. The temporary relief gained by the dance led to the adoption of the remedy at intervals, which ultimately became yearly; every summer the sufferers grew depressed in anticipation of the advent of the annual dance. Strange psychical conditions were induced by the emotional disturbance; other sensory impressions besides music gave pleasure; and certain colours, such as red, or the sight of the sea or even of clear water, exerted a strange fascination. The sexual passion became involved in the tumult of emotion, and the mental excitement occasionally ended in self-destruction. Of longer duration than the dancing epidemics of Northern Europe, tarantism was at its height in the seventeenth century, and gradually died out in the eighteenth, leaving only a designation for a lively dance as its harmless legacy.

W. R. GOWERS.

TARASP - SCHÜLS, in Unter-engadin, Switzerland. — Alkaline sulphated waters. *See* MINERAL WATERS.

TARKASTAD, in Cape Colony.— *See* AFRICA, SOUTH.

TARTAR EMETIC, Poisoning by. SYNON.: Fr. *Empoisonnement par l'Antimoine*; Ger. *Antimoniumvergiftung.*— Poisoning by tartar emetic, a soluble double tartrate of antimony and potassium, is not very common. The emetic properties of the salt generally ensure its speedy ejection from the stomach. Poisoning by the salt may be either (1) *acute*, from the ingestion of a large dose; or (2) *chronic*, the patient succumbing under the exhaustion consequent upon its prolonged administration.

1. **Acute poisoning.**—Shortly after taking a large dose of tartar emetic, the patient is seized with intense nausea and faintness, accompanied by depression of the force of the pulse, and increased perspiration. Violent vomiting and retching follow, with a burning pain and sense of constriction in the mouth, throat, and gullet. Vomiting affords no relief to the nausea and pain, and is repeated, the vomited matters becoming bilious, and ultimately perhaps blood-tinged. A metallic taste is felt in the mouth; the abdomen becomes painful and tender; and profuse diarrhœa sets in, the fæces often containing a considerable quantity of blood. The urine is at first increased in quantity; but later it may be scanty, blood-tinged, or suppressed. The circulation is throughout depressed; and the skin cold, clammy, and bathed in profuse perspiration. The muscular system is relaxed; but cramps of the extremities may torture the patient. In rare cases a pustular rash appears, like that produced by the external medicinal application of the drug. In some cases neither vomiting nor purging has occurred, the symptoms being simply those of intense prostration, with embarrassed respiration. In fatal cases death occurs within a few hours.

2. **Chronic poisoning.**—The administration of repeated small doses of tartar emetic causes nausea, vomiting, purging, exhaustion, and debility, which not infrequently prove fatal. These symptoms are accompanied by depressed irregular circulation, profuse perspiration, and disturbances of respiration.

ANATOMICAL CHARACTERS. — These are somewhat variable, but on the whole are those of a metallic irritant poison. In most cases there is inflammation of the stomach and intestinal tract generally, not so patchy or marked by such bright redness as in arsenical poisoning. Not infrequently the stomach and small intestines escape, and the inflammation may be confined to the large bowel; even ulceration of the intestines may occur, accompanied by hæmorrhagic extravasations. Hypostatic congestion of the lungs is often prominent.

DIAGNOSIS.—Poisoning by tartar emetic may be diagnosed from other irritants, especially arsenic, by the greater and earlier depression, the profuse perspiration, greater irregularity of pulse, and the more irregular respiration. An analysis of the ejecta or of the urine is always advisable, and often indispensable to complete the diagnosis. In chronic cases an analysis of the urine is the only satisfactory mode of determining the nature of the illness, where tartar emetic is not known to have been administered as a medicine.

PROGNOSIS.—This must always be grave, so long as the ejecta contain considerable quantities of the poison. In acute cases the patient cannot be considered out of danger till not only the vomiting has ceased, but an obvious return of strength has set in for some time.

Fatal dose. — Fifteen grains may prove fatal to an adult. Much larger doses may, however, as a rule, be taken with impunity. The danger is much increased if the poison be taken in conjunction with some substance, such as opium, which deadens the susceptibilities of the stomach.

TREATMENT.—The stomach-pump may be used, notwithstanding profuse vomiting. The elimination of the poison may be hastened by free administration of diluents, and the stomach protected by mucilaginous drinks, or the stomach may be washed out by means of the siphon-tube. The most effective antidote is tannic acid, which forms an insoluble tannate of antimony. For this purpose tincture of cinchona bark, decoction of oak-bark, or strong infusions of tea or coffee, may be administered; or the stomach may be washed out with similar fluids, or with a solution of half a drachm of tannic acid. Not till after this has been done, or the stomach well and repeatedly cleansed by free vomiting, should opium be administered. The after-treatment will depend upon the symptoms. The treatment of chronic cases consists in cessation of the administration of the poison; in the exhibition of ammonia, stimulants, and tonics; and in careful support of the strength. Nutrient and opiate enemata are of the greatest service.

THOMAS STEVENSON.

TASMANIA.—A warm, equable, subtropical climate. Mean temperature of Hobart Town, the capital, 54° F. Prevalent winds, N.E. and S.W. *See* AUSTRALASIA; and CLIMATE, Treatment of Disease by.

TASTE, Disorders of.—SYNON.: Fr. *Troubles du Goût*; Ger. *Störungen des Geschmackes*.

INTRODUCTION.—Disorders of taste have to be carefully distinguished from disturbances of olfactory impressions, on which all perception of flavour depends. The chief sensations of taste are those called sweet, sour, salt, bitter, and metallic. Flavours are sensations of smell due to an agent which reaches the olfactory mucous membrane through the posterior nares; their cause usually at the same time acts upon the nerves of taste, so that the flavour blends with the gustatory sensation, and seems like a part of taste proper. But if the passage of air into the nasal cavities by the posterior nares is prevented, as by closing the nostrils, no flavour is perceived and taste alone remains. It is also necessary to distinguish disorders of taste from altered appreciation of the sensation—increased or diminished enjoyment of, or disgust at, sensations which are themselves normal.

The sensation is subserved by structures in the mucous membrane on the back of the tongue, the palate and palatine arches, and to a slighter extent by those on the tip and edges of the fore-part of the tongue. In the latter sweet and sour, in the former salt and bitter, are best perceived; but, except for individual peculiarities, all the sensations can be perceived in each region. The sense is related especially to certain 'papillæ' on the back of the tongue, but elsewhere to less differentiated structures of the mucous membrane. Substances must be dissolved to excite the sensation, but the solution may be effected by the moisture on the tongue. A knowledge of these facts is important for testing the sense of taste.

In the front of the tongue the sensation is certainly subserved by fibres from the lingual branch of the fifth, belonging to this nerve, but reaching its root by a circuitous path—the chorda tympani, facial, and Vidian nerves, spheno-palatine ganglion, and thence to the fifth by the petrosal nerve. The nerve-fibres connected with the papillæ at the back of the tongue are those of the terminal branches of the glosso-pharyngeal, but disease of this nerve within the skull does not impair taste, and destruction of the root of the fifth nerve abolishes it, not only on the back of the tongue, but also on the palate. Exceptions to this rule are probably due to imperfect destruction of the root, or to the disease of its fibres being within the pons. Hence it seems that the taste-fibres from the back of the tongue leave the glosso-pharyngeal, just as those from the front of the tongue leave the lingual, and reach the root of the fifth by an equally circuitous path, probably (from other pathological facts) chiefly by the tympanic nerve of Jacobson.

Within the pons, the fibres for taste seem to take a course separate from the sensory roots, and at first near the motor fibres or nucleus, since the writer has met with complete loss of taste and paralysis of the muscles of mastication on one side, without anæsthesia, from disease within the pons. The path ascends to the opposite hemisphere of the brain, but the position of its cortical centre is not known.

1. **Increased Sensitiveness of the Nerves of Taste.** — SYNON.: Gustatory Hyperæsthesia; *Hypergeusia.*—This condition is evidenced by detection of a substance too minute in quantity to be perceived by normal taste, or by an abnormally intense impression when a given quantity of a substance is tasted. In excitable states of the nervous system, as in general malnutrition, substances in small quantities in the blood are tasted with great readiness; the bitterness of morphine injected beneath the skin may be at once noticed (Wernich), and, for a long time after a bitter substance has been taken, whatever is tasted may seem bitter. Gustatory hyperæsthesia is often met with in hysterical persons, and sometimes in the insane. It is not usually a symptom of sufficient prominence to demand special treatment.

2. **Perverted Sense of Taste.**—SYNON.: Gustatory Paræsthesia; *Parageusia.*—This is not uncommon in neurotic states. Substances excite a different taste from that to which they naturally give rise. A bitter flavour, for instance, is detected in a simple saline. This condition is commonly conjoined with altered appreciation of the taste which is recognised, so that substances commonly considered pleasant are disliked, and those are enjoyed which commonly excite disgust. It is seen in a slight degree in some toxæmic conditions, but more frequently in psychical disturbances. In hysteria it leads to various absurdities in diet. It is also met with, as a rare symptom,

in some degenerative diseases, such as locomotor ataxy.

3. Subjective Sensations of Taste.—These may occur from disorders of the central nervous system, in hysteria, insanity, and occasionally as the aura of epileptic attacks. The sensation is usually of an unpleasant description, and is probably produced in the region to which the taste-fibres are conveyed by the branches of the glosso-pharyngeal nerve. It is remarkable (as evidence of the association of the cerebral centres in correspondence with that of the causes of sensation) that distinct flavours and tastes are combined in epileptic aura, but an odour is always separate.

Subjective sensations of taste occur also, very rarely, from irritation of the gustatory nerves. They have been produced experimentally by galvanising the chorda tympani, when this has been exposed by disease of the internal ear; and have also occurred in some cases of disease of the petrosal part of the facial nerve. These subjective sensations have to be distinguished from abnormal sensations due to substances in the blood, or to secretions of the mouth. The treatment of the symptom is that of its cause.

4. Loss of the Sense of Taste.—Synon.: Gustatory Anæsthesia; *Ageusia.*

Ætiology. — Diminished sense of taste may be produced by: (*a*) Thickening or other changes in the mucous membrane of the mouth, rendering the nerve-endings less accessible to sapid solutions. This is, however, a rare cause. (*b*) Local applications lessening the irritability of the nerve-endings. Hot or cold applications may temporarily destroy the sense of taste. Cool substances cannot be tasted so well as those which are warm. (*c*) Hysterical and other functional nervous disturbances. It then forms part of 'hysterical hemianæsthesia' as part of the unilateral loss of the special senses, accompanied by anæsthesia of the limbs and half of the trunk on the corresponding side. (*d*) A similar loss, in the same association, has been met with in rare cases of organic disease of the opposite hemisphere. (*e*) Disease of the nerves which conduct the sensation to the sensory root of the fifth nerve, especially of the tympanic plexus, in consequence of caries of the temporal bone. It is also often produced, in the front of the tongue, by disease of the chorda tympani, when a neuritis of the facial nerve passes up its canal.

Symptoms.—Loss of taste involves the perception of bitter, sweet, sour, and saline characters, to which should, perhaps, be added the metallic quality. These may be lost in varying degrees, sometimes entirely; occasionally some are more impaired than others. The loss, from disease of the nerves, may be on the whole or part of one side, according to the relation of the several nerves to the function in different parts of the gustatory region, as already explained. Each part of the tongue possesses the power of recognising every quality, but not in the same degree; bitterness and sweetness are appreciated chiefly by the glosso-pharyngeal at the back, acidity and saltness by the lingual in the fore-part of the tongue, chiefly at the tip and edges. The onset of the defect may be sudden, as in hysteria; or gradual, as in most forms of nerve-lesion. In the latter it is usually unilateral; in rare cases both sides are involved. It is associated with other symptoms of loss of function of the affected nerves, as in the case mentioned, in which there was loss of sensibility in the face and paralysis of the muscles of mastication.

Diagnosis.—Loss of taste has always to be carefully distinguished from loss of smell, since all flavours are recognised by the olfactory nerve, and it is commonly assumed that when these cease to be perceived, taste is lost. The power of tasting must be ascertained by powders or colourless solutions which shall convey no information. Citric acid, quinine, sugar, and salt, in powder or solution, answer well. The tongue must be held out, and the substance or solution placed on the part of the tongue it is desired to test, and after each observation the mouth must be rinsed with water. It must be remembered also that the anterior part of the tongue is almost destitute of the sense of taste, except on the edges and tip. If the loss is unilateral, the powder may be rubbed on the side of the protruded tongue, near the tip, with the finger, and the patient should indicate, by nodding or shaking the head, whether it is tasted, before the tongue is withdrawn into the mouth. The moisture on the mucous membrane is sufficient to dissolve the substance and enable it to act upon the nervous structures.

Prognosis.—This depends on the cause, and the extent to which the morbid condition can be influenced by treatment. It is good in hysteria, less favourable in nerve-affections. The loss due to affection of the facial nerve is frequently recovered from, but may prevail even when the function of the latter is recovered. In intracranial disease of nerves the prognosis is, as a rule, unfavourable.

Treatment. — The treatment in nerve-disease is that of the cause of the symptom. Stimulation of the nerves in the tongue may sometimes aid the recovery of function, and for this faradisation is the most effectual. Hysterical loss of taste, part of hemianæsthesia, is best treated by neglect. Where the loss depends on an affection of the mucous membrane of the tongue, local measures alone are effective, in so far as the treatment can be influenced.

W. R. Gowers.

TEETH, Diseases of.—SYNON.: Fr. *Maladies des Dents*; Ger. *Krankheiten der Zähne.*

INTRODUCTION.—The teeth are peculiar organs, both anatomically and physiologically. The three hard tissues of the teeth are of comparatively low organisation, while they are in connexion internally with a structure, the pulp, mainly composed of plexuses of nerves and blood-vessels, and the roots are covered externally with a highly nervous and vascular periosteum.

The functions of the teeth are important. They exercise a large influence in the production of articulate sounds. They have a keen tactile faculty, by which they recognise the texture of food, and detect the presence of foreign bodies. But their most important function is mastication, by which food is comminuted and at the same time insalivated, two essential preliminaries to digestion. The loss of the teeth is with many of the lower animals the limit of life, from the cessation of these processes; and the failure of mastication, through edentulous age, is a frequent cause of intractable dyspepsia in the human subject. This fact cannot be too constantly remembered by the practitioner. The restoration of mastication by means of artificial teeth is often the immediate cure of imperfect digestion, which diet and drugs have failed to influence.

The diseases of the teeth are for the most part of a surgical character, and need operative interference. Their pathological conditions are, however, of important interest to the medical practitioner; causing and explaining, as they do, many maladies especially of the nervous system, and having a serious bearing on digestion and nutrition, as dependent on efficient mastication.

Again, the forms of the teeth, and the characters of their tissues, are frequently indicative of former illness, and in many instances are of critical diagnostic value in establishing the existence of a constitutional taint which may modify or develop disease. The teeth are dermal organs, and as such are liable, especially during their development, to be affected by the poison of the eruptive fevers, leading to disastrous consequences to the teeth themselves, and to the immediately contiguous structures.

The teeth, are, moreover, from their peculiar position and surroundings, liable to mechanical injuries, and to chemical and physical changes of the most interesting nature in themselves, and in relation to the vital manifestations to which they lead.

In this article the morbid conditions associated with the teeth will be discussed in the following order: (1) Alveolar Abscess; (2) Caries; (3) Enamel, Pitted; (4) Erosion; (5) Eruption of Wisdom Teeth, Difficult; (6) Hæmorrhage after Tooth-extraction; (7) Irregularity in Number, in Shape, and in Position; (8) Loosening; (9) Necrosis of the Jaw and Teeth after the Eruptive Fevers; (10) Nervous Affections dependent on Diseases of the Teeth; (11) Odontomes; (12) Periosteum, Diseases of Dental; (13) Pulp, Diseases of; (14) Syphilitic Teeth; (15) Toothache.

1. Alveolar Abscess.—*See* 12. Periosteum, Diseases of Dental.

2. Caries.—Caries of the teeth is the most common pathological change to which the human body is liable. It generally affects some of the temporary teeth before they are shed; and there are very few adults in whose teeth caries, in some degree, is not to be found. Dental caries is a softening and disintegration of the tooth's surface, gradually penetrating towards its centre. It is essentially an affection due to external influences, which are partly chemical and partly parasitic in nature.

ÆTIOLOGY.—The *predisposing causes* of dental caries are local, and general:—

Local.—These include: (*a*) Defective enamel—pits, &c.; deficiency of lime-salts throughout tooth. (*b*) Irregularity—favouring lodgment of food. (*c*) Want of cleanliness. (*d*) Abnormal condition of secretions; acidity; mucoid condition of saliva in fevers.

General.—Under this head come: (*a*) Heredity—probably through deficiency of lime-salts. (*b*) Pregnancy. (*c*) Occupation: *e.g.* millers, bakers, confectioners, or chemical workers. (*d*) Civilisation—through kind of foods; cooking of food; brain activity. (*e*) Rheumatism, gout, diabetes mellitus, dyspepsia.

The *exciting causes* are—chemical solvents, acids which remove lime-salts, lactic acid produced in transformation of carbohydrates, fruit acids, acids in medicines—especially the mineral acids.

DESCRIPTION.—When the enamel is attacked by caries, it becomes opaque, whitish, or grey; and then gradually stained of a brownish colour. This change is soon followed by still more obvious lesions in the dentine. The latter tissue undergoes more rapid alteration than the enamel; it becomes brown and soft, and the disease penetrates in the direction of the tubes towards the pulp, while it spreads laterally beneath the as yet healthy enamel. These changes occur in endless variety, one form passing into another. The extreme varieties have been described as distinct species of decay, without, however, sufficient justification.

At times the disease advances to a certain stage, and then ceases; the intra-tubular material becomes calcified, and the surface perfectly hard and dull-brown or black in colour. This is called 'arrested,' 'stationary,' or 'carbonised' decay. There is a peculiar and characteristic odour in dental caries, like that of gangrene of the lung; or like the scent of the little neuropterous insect

'*Chrysopa*.' The softening of the dentine is brought about by the removal of the phosphate of calcium in a soluble acid form, and its replacement by water. Carious dentine has an acid reaction.

The results of caries are many and serious, arising from removal of protection from the pulp and specific irritation of it. Toothache, neuralgia, periostitis, suppuration of the pulp, alveolar abscess, and occasionally muscular paralysis, may all arise as consequences of this condition.

TREATMENT. — The treatment of dental caries may be divided into *prophylactic*, and *remedial*.

Prophylactic treatment should be directed against overcrowding of the teeth by judicious extraction; and against want of cleanliness by the use of the tooth-brush and antiseptic washes and dentrifices. The various diseases causing acidity suggest their own treatment. Iron medicines should be taken through a glass tube, and the teeth brushed immediately after with water made alkaline by bicarbonate of sodium.

Remedial treatment cannot be called curative, as there is no restoration of lost tissue; and that which has become decalcified never hardens again. But caries may be arrested, and further decay prevented. The softened tissue should be removed; the hard subjacent structure polished and kept smooth; projecting edges, which might entangle food, levelled and burnished; and above all, cavities should be stopped.

3. **Enamel, Pitted.**—SYNON.: Mercurial Teeth—Hutchinson.

It is of great importance to distinguish between syphilitic teeth and other malformed teeth which have no similar signification. When Mr. Hutchinson first described the characters of teeth which are often associated with inherited syphilis, much unnecessary distress was occasioned by confounding teeth having rocky and pitted enamel with those which were truly syphilitic in their origin; and many persons supposed themselves to inherit syphilis, who merely possessed teeth bearing marks upon them which registered a temporary illness, or a condition of depressed nutrition in childhood when the affected teeth were forming. Teeth with rocky and pitted enamel vary indefinitely as to the extent of their defective formation, from a slight horizontal grooving in the enamel, to a condition in which the whole surface is rocky and rugged, and studded with pits like a thimble. In extreme cases the enamel may be almost entirely wanting; but there is *no narrowing of the apices of the crowns of the teeth, and no crescentic notch in the superior incisors*, as in syphilis. The defects of the enamel are nearly always horizontal in their disposition; and even the pits have such an arrangement in series. This condition is most frequently seen in the permanent teeth, though sometimes in the temporary. It is most manifest in the first molars, the incisors, and the canines. Rarely it affects the bicuspids, near the apices of the cusps; and still more rarely the whole bicuspid crown suffers. But it will be observed that the malformation is symmetrical in the corresponding teeth, and that in the different teeth it has occurred at a point in its development which each tooth had attained at one particular time; and probably the mildest and severest cases are essentially the same in their pathological meaning, the difference being only one of degree. It has been supposed by Mr. Hutchinson that this condition of teeth is the result of the constitutional influence of mercury given in childhood; but it is generally quite unconnected with such supposed cause, as it is extremely rare for mercury to affect the mouth in children. This condition of teeth occurs where mercury has never been given, and equally among people not accustomed to that drug. It is found, moreover, among extinct races, who lived before mercury was used as a medicine. The microscopical structure of teeth, thus degenerated, shows that the condition is essentially one of imperfect calcification of the enamel and dentine; and any influence or disease of childhood, suspending for a time or depressing the nutrition, may be an efficient cause. As this state of tooth is permanent, it remains a record through life of an illness in childhood. These defects in the tissues of the teeth are concurrent with their lamination. The tissues of the teeth exhibit a series of layers due to different degrees of calcification, in which the earthy impregnation has been greater and less alternatingly. This is a normal condition up to a certain degree; but when the laminæ of lesser calcification are extremely defective in earthy matter, histological defects arise, which lead to the appearances in the teeth described.

4. **Erosion.**—Erosion is the name given to the process by which saucer-shaped cavities or grooves are formed on the labial aspects of the necks of the teeth. They are generally placed transversely; and though at times attacking all teeth, are most frequently seen on front ones. The surface of erosion is hard, polished, and often not at all discoloured until the pulp is approached; and the teeth attacked frequently become so weakened as to break off. Erosion seems to be due to a chemical solvent, the source of which is probably the gum margins.

TREATMENT.—The cavities due to erosion should be filled if deep enough; otherwise the sensitiveness generally present should be treated by nitrate of silver, in the form of the solid pencil, or chloride of zinc; or let the patient occasionally paint the parts with sal volatile.

5. Eruption of Wisdom Teeth, Difficult.—Insufficiency of room in the jaw for the advent of the wisdom teeth is sometimes attended with very painful, and even serious symptoms. These are confined to those cases in which the obstruction occurs in the lower jaw. The wisdom tooth has insufficient room to come through, and remains impacted at the base of the ascending ramus of the jaw, growing and pressing against the second molar. This gives rise to inflammation, and pain of a rheumatic character, wandering down the neck and arm, the latter being often weakened in muscular power. In acute and neglected cases, abscess forms at the angle of the jaw, and burrows about the cheek. One remarkable symptom is trismus, which is very usual in these cases, and is a characteristic symptom; the masseter muscle becoming contracted and firmly set, so that the jaws can hardly be opened a quarter of an inch. This locking of the jaw sometimes occasions very unnecessary alarm.

Well-authenticated instances of epilepsy, delirium, and insanity have been recorded as having been occasioned by the resisted eruption of the lower wisdom teeth, and cured by removal of the cause of irritation. Upper wisdom teeth occasionally give trouble by growing into and ulcerating the cheek.

Treatment. — The treatment depends much on the degree of obstruction. Lancing the gum is sometimes sufficient; otherwise removal of the wisdom tooth is the proper cure. Where there is trismus, it is necessary to force open the jaws with a Mason's gag under an anæsthetic, and then extract the tooth if possible. If it cannot be reached, the second molar should be extracted, when its posterior fang will sometimes be found absorbed. When once an abscess has formed in association with an obstructed wisdom tooth, the removal of that tooth is unavoidable. Though it may be necessary to remove the second molar first, the third must afterwards follow, or the abscess will remain. The trismus vanishes on extraction of the tooth.

6. Hæmorrhage after Tooth-extraction.—Hæmorrhage following tooth-extraction may be either *primary* or *secondary.*

Primary hæmorrhage is rarely persistent. The duration seems to depend on the amount of laceration. The portion of the socket formed by the alveolar plate will often be found to bulge after an extraction. When this occurs, the bleeding is often prolonged, probably because the fracture of the outer plate opens up the cancellous tissue of the bone.

Treatment. — The proper treatment for hæmorrhage of this kind is to squeeze the outer and inner plates together. Very hot or very cold water generally stops the bleeding at once. Should this fail, the treatment should be that for secondary hæmorrhage.

Secondary hæmorrhage is very rare, considering the number of teeth extracted. There is frequently a history of the hæmorrhagic diathesis. It is sometimes, however, associated with menstruation.

Treatment. — Various general remedies have been tried, such as hamamelis, turpentine, and the like. But it is on *local* treatment that the practitioner depends. It is advisable to remove any badly formed and leaking clots. Then syringe the socket with hot water, and examine for torn gum, or alveolar splinters; and a tent-shaped roll (rough side out) of matico leaf should afterwards be inserted into the apex of each root-socket.

The following plan is often most effective: Twist a small cone of cotton wool on the sharp end of a straight silver probe. Dip it into Richardson's styptic colloid, and carry it to the apex of each socket. If the cotton wool be firmly but not tightly rolled, the probe can be withdrawn quite easily, provided the point is smooth and straight. The cone of wool rapidly expands and is retained in the conical socket. Hamamelis, or saturated solution of tannic acid in alcohol, may be used instead of the colloid. Should plugging alone fail to stop the bleeding, pressure must be tried in addition. This may be obtained by getting the patient to bite on a pad of lint or cork, and then bandaging the chin tightly up with a four-tailed bandage. Special tourniquets and clamps have been devised for this purpose. The actual cautery has been used, but it is rarely needed.

7. Irregularity in Number, Shape, and Position of Teeth.

(*a*) *Number.*—*Absence* of one or more teeth is common. The deficiency may be caused by removal of the permanent germ, during extraction of a temporary tooth, or possibly by the germ being affected by the diseases of childhood. Hereditary absence of teeth is frequently noted. The modern diminution in size of the lateral incisor and wisdom teeth points to their gradual elimination from their respective series. Non-eruption of the wisdom-teeth is very common. A retained temporary tooth will often be found filling the place of an absent permanent one; and this may sometimes be the cause, and sometimes the effect, of absence of the permanent tooth. *Supernumerary teeth* are occasionally seen. They are generally found in the upper jaw, and are most commonly irregular in shape and position. Their removal is necessary when they cause overcrowding, inconvenience, or disfigurement.

(*b*) *Shape.*—The lateral incisor and wisdom teeth are most commonly affected. There seems to be a tendency for the overcrowding in modern jaws to be relieved at the expense of these teeth. Amongst people whose mouths do not show this overcrowding, these teeth are better developed.

(*c*) *Position.*—Irregularity in position is very common, and overcrowding is the general cause. The human jaw is diminishing in greater ratio than the teeth which have to occupy it. This is partly the result of sexual selection, and partly of want of exercise, brought about by the highly prepared foods of modern civilisation. Possibly also early mental activity at the time the jaw is developing, causes the brain to receive an undue share of the phosphates in the blood-supply to the head. Heredity would also have its influence. Too early extraction, and too long retention of temporary teeth are causes of malposition. Obstructed nasal breathing and thumb-sucking must be included in the same category.

8. Loosening of Teeth.—*See* 12. Periosteum, Diseases of Dental.

9. Necrosis of the Jaw and Teeth after the Eruptive Fevers. — Necrosis of the jaw and teeth is among the secondary maladies which is apt to occur after small-pox, scarlet fever, and measles in children, and the cases are all singularly alike. They usually occur between the third and eighth years, and the severity of the previous attack of fever is immaterial. The local symptoms, which usually appear from three to six weeks after the primary disease, consist in a separation of the gum around one or more of the temporary teeth; and this continues until the bare jaw is exposed to a depth which corresponds not only to the fangs of the temporary teeth, but to the bony capsules of their immature successors. Transverse ulceration then usually follows; and the temporary teeth, their alveoli, the immature permanent teeth, and their bony capsules are shed. Frequently this occurs on both sides of the mouth symmetrically. There is no swelling or formation of supplemental bone. In the lower jaw, the base of the bone is rarely, if ever, involved; and the consequent disfigurement is singularly slight. These exfoliations occur much more frequently after scarlet fever than after measles; and they are rare after small-pox.

Treatment.—The treatment of these cases should consist in as little local interference as possible. Little need be done, beyond attention to cleanliness and deodorisation, and the removal of the sequestra when quite loose. The general condition of the patient will require careful treatment.

10. Nervous Affections Dependent on Diseases of the Teeth.—Affections of the nervous system dependent on the teeth, independently of dentition, have not been sufficiently recognised, and records of them are so few and partial that it is difficult to generalise upon them. These affections are either (*a*) *reflex*, (*b*) *direct*, or (*c*) *complex*. In the first case some portion of the nervous system receives an exaltation of function from the irritation of a tooth-nerve: in the second case some contiguous nerves are involved by the spread of inflammation from diseased teeth, or the pressure of the inflammatory products: in the third case both would be entailed in a mixed and uncertain proportion.

(*a*) *Reflex affections.*—As regards the reflex phenomena of disease dependent on the teeth, we may enumerate pain; muscular spasm; muscular paralysis; paralysis of some of the nerves of special sense; and perverted nutrition. These reflex phenomena have been found to be induced by the following diseases: Caries, with or without exposure of the pulp; exostosis—hypertrophy of the crusta petrosa; nodular developments of dentine in the pulp-cavity; periostitis, plastic or suppurative; impaction of permanent teeth in the maxillary bones; and crowding of teeth from insufficient room.

Small excrescences of dentine occurring within the pulp-cavity (or in the form of small nodules in the substance of the pulp) are apt to produce erratic and widespread pain among the dental nerves of one side of the face. The same symptom not infrequently occurs where the morbid change consists of fine nodular exostoses on the fangs of the teeth. In these cases the pain is radiated from the spot of irritation over a large nervous area; but the tooth containing the offending growth is usually perceptible by tenderness or elongation, or a consciousness on the part of the patient that it is the centre of offence. Where it arises from an exostosis it is apt to be repeated with several teeth one after another. These cases are by no means uncommon, and are often made the subjects of unavailing medical treatment for a long time. Extraction of the tooth is the only remedy.

Wry-neck, epilepsy, and tetanus are three forms of muscular spasm which have been distinctly traced to the irritation of disease of the teeth in the adult. So likewise have been symptoms of angina pectoris.

Among the nerves of special sense which have been affected by reflex nervous action from tooth-irritation are the auditory and the optic; cases of deafness and of complete amaurosis having arisen from these causes.

There is a not infrequent form of muscular and sentient paralysis, affecting one or other of the arms, which has often been wrongly diagnosed, and led to much needless suffering and alarm. It consists of weakness, some pain, and occasionally loss of sensation in the arm and hand in question. Pain frequently commences in the side of the neck, or at the point of the shoulder; and is of an aching, weary character, much increased by any muscular effort of the limb, which usually hangs in a powerless listless attitude by the patient's side. The hand is feeble, and the patient has difficulty in grasping and shaking hands with cordial pressure. These symptoms are sometimes only induced by exertion. Such cases have been frequently supposed to depend on central nervous disease, and have been so treated. They may depend, however, on some irritation of a tooth of the lower jaw, usually a back molar, which is transmitted through the cervical and brachial plexuses of nerves. A carious or impacted wisdom-tooth is often the cause. Extraction of the tooth is followed by complete relief within a few hours. There are also on record some curious cases of perverted nutrition, in which the colour of the iris has been altered, and the hair at certain spots has become abruptly white; and ulcers have formed and refused to heal, in the neighbourhood of the neck and cheeks, all dependent upon dental irritation.

(*b*) *Direct affections.*—Direct affections of the nervous system, caused by tooth-disease, are far less common and less varied than those which are reflex, and their mode of production is more obvious and intelligible. The portio dura of the seventh nerve, the nerves which enter the orbit, and, very rarely, the dental nerves in their tracts in the jaw, are those only which suffer in this way, that is, are entangled in their course by those inflammatory influences and products which diseases of the teeth engender.

The consequences of the direct implication of nervous trunks by the inflammatory results of these diseases are so very grave, especially when affecting the nerves of the eye in their course to the orbit, and the ultimate results are so likely to become permanent when relief is not speedily given, that it is impossible to exaggerate their importance. Great stress must be laid upon this subject, because such cases may be misunderstood; and injuries have thus become permanent and irremediable, which, if correctly interpreted and properly treated at first, would have been easily obviated.

The entanglement of the portio dura leading to facial palsy has arisen from the plastic exudation around an upper back molar, and has been immediately cured by the extraction of the tooth. Instances have also been observed in which the nerves passing into the orbit, and probably within the orbit, have been surrounded with plastic exudation leading to the destruction of their functions, and to temporary or permanent loss of sight. The writers have seen several such cases; some were, and all might have been, completely cured by the early removal of the offending teeth. It is very rare indeed for the dental nerves in their passage through the jaw-bones to be pressed upon and functionally disturbed by the inflammatory products of carious teeth. But such cases have occurred, producing loss of sensation of the front teeth, lips, and chin.

(*c*) *Complex affections.*—In some instances the nervous symptoms are clearly of a mixed character, partly reflex and partly direct. This is no doubt the case in those remarkable and not infrequent examples of trismus, in which the jaws are firmly closed by the spasmodic action of the masseter muscle, on the side where a carious or impacted lower molar tooth is keeping up irritation, and which is quickly cured by the extraction of the tooth.

The same may be said of those widespread and diffused pains, attended with extreme tegumentary sensibility, which so often accompany ordinary toothache.

11. **Odontomes.**—These are congenital fibro-plastic or osseous tumours, the result of morbid changes, such as hypertrophy and degeneration in the forming tooth.

12. **Periosteum, Dental, Diseases of.**—Under this heading we note the various phases of inflammation—from hyperæmia to suppuration (including a peculiar form of chronic inflammation, probably infective, which has received the name of *pyorrhœa alveolaris*, or Riggs's disease); mention must also be made of associated troubles, such as necrosis, exostosis, and absorption of the tooth-roots. Cysts also may be considered under this head.

(*a*) *Periostitis.* — Synon.: *Periodontitis*; *periamentitis.*—Dental periostitis may be acute, chronic, or diffuse.

When the nerve-pulp is dead and not aseptically treated, or perhaps is inflamed, either by caries, or by fillings injudiciously inserted, or by cold, the tooth may become tender to bite on, and slightly long and loose in consequence of *hyperæmia.* The inflammation may resolve, or the tooth become acutely tender or aching, and the gum over it red and injected; *acute periostitis* is now present. Resolution is still possible, but often suppuration ensues, the nerve, if previously alive, having meanwhile died; and the pain is intense, and worse at night; the gum swells, and pus is seen to be pointing; an *abscess* has formed. Relief is experienced by evacuation; the vent on the gum remains (*gumboil*), and the tooth settles down. A tooth may remain chronically tender, with periodic exacerbations, constituting *chronic periostitis*; and when so affected generally becomes tartar-covered and discoloured from lack of use.

Treatment.—The treatment of dental periostitis should be local and general. Locally, scarification or leeching of the gum is indicated in the early stages. Later stages demand counter-irritation, for instance, by means of a combination of 1 fluid drachm each of Fleming's tincture of aconite and liniment of iodine, and 10 minims of chloroform; which is painted on the gum; or capsicum plasters may be applied over the roots. The pointing of pus should be favoured by fomentation inside the mouth; and an abscess opened directly it points.

The general treatment should be a smart

purge at first, and perhaps tonics later in the case of enfeebled patients.

(*b*) *Diffuse Periodontitis.*—When this disease exists on both sides in both jaws, it is generally due to—(1) *Traumatism*—*e.g.* violent closure of the jaws by a blow; (2) *diatheses*—rheumatism, gout, syphilis, scrofula; or (3) *ptyalism*—referable to mercury chiefly; but also sometimes to copper, arsenic, or iodide of potassium.

The teeth are raised and tender, and the gum around them is congested. No suppuration occurs.

Treatment.—Hot fomentations of boric acid lotion are indicated for traumatic cases. Iodide of potassium will be useful for most of the others, combined with a mouth lotion of chlorate of potassium. Adynamic cases should have generous diet, port-wine, and quinine.

One or two teeth will sometimes cause tenderness of all the teeth on one side. Usually the cause is obvious.

(*c*) *Pyorrhœa alveolaris.*—This disease was first described by Riggs. It appears to be a chronic inflammation of the edges of the periosteum. It advances slowly in a ring-like manner from the neck towards the apex of the root, whilst ordinary periostitis spreads from the apex. As the alveolar edges are destroyed *pari passu* with the progress of the inflammation, the tooth or teeth become looser and looser, and are finally lost. The disease is probably mildly infective, and tends to spread through the medium of the pus which is constantly oozing from the margins of the gums. There is usually neither tenderness nor pain till a late stage. It attacks front teeth mostly, and when limited, as it frequently is at the start, it appears to have been excited by local irritants—food, tartar, or undue pressure of the bite.

Certain diatheses predispose to pyorrhœa, such as the gouty or rheumatic; and so do the specific fevers and valvular heart-disease, or other conditions in which there is congestion of the vessels of the periphery. Mercurial salivation also doubtless tends to produce it. In some of these cases the disease is present in all the teeth. Mr. Hutchinson calls it *sycosis dentium*; and compares it with *sycosis tarsi*.

Treatment.—This is a very intractable disease. Cure is seldom attained, and continuous attention is necessary to prevent it from getting worse and affecting other teeth. All tartar should be removed. Having painted the gum margins with cocaine solution (20 per cent.), we must syringe each one carefully and forcibly; then apply some strong antiseptic beneath the gum-margins, with a splinter of wood. Aromatic sulphuric acid and sulphate of copper crystals, powdered and mixed into a paste with pure carbolic acid, are favourite remedies. This procedure, alternated with the use of an astringent mouth-wash, such as tannic acid and eau-de-Cologne, seems the best available treatment.

(*d*) *Cysts.*—Cysts are occasionally found in connexion with the roots of diseased teeth as painless, slow-growing, bony swellings. The contents are fluid, often containing cholesterin flakes. Extraction of the tooth is the only remedy as a rule.

(*e*) *Necrosis.*—Necrosis is the term limited by usage to denote death of the cementum at any part, owing to more or less separation of the periosteum. It may be partial; and may exist coincidently with a living pulp and dentine; or it may be complete, in which case the whole tooth (dentine and cementum) is dead, and is soon shed by nature as a foreign substance. Partial necrosis may be due to abscess, pyorrhœa alveolaris, or exposure of a root by gum-absorption. Treatment is only possible in so far as it can combat these causes.

(*f*) *Exostosis.*—Dental exostosis is a disease resulting in an undue thickening of the cementum. It may occur as nodular excrescences; or as a general even thickening of the root. Sometimes it is obviously due to previous inflammation in an isolated tooth; in other instances it is present in several teeth, and has no such apparent connexion with pathological action. Frequently, perhaps most often, this condition may be present without any symptoms, such as pain, to lead one to suspect it; but sometimes it is the cause of tic-douloureux. After excluding other causes of pain, as caries and erupting wisdoms, such cases may appear idiopathic. At times the patient may indicate a certain tooth as the focus, which is apparently quite sound. It is fortunate, indeed, when a slight tenderness on rocking laterally confirms this. An isolated molar, whose well-worn top indicates that it has borne the greater share of mastication, is frequently the subject of exostosis.

Treatment.—The only remedy is extraction. In cases on record the pain has recurred in another tooth when one has been removed, and the roots of all showed this affection to be present. It is suggested that the diffuse periostitis of rheumatism and gout may lead to this wholesale exostosis, and hence treatment may be directed to these diseases.

(*g*) *Absorption.*—A process similar to the physiological one which causes the shedding of temporary teeth may occur pathologically in the roots of permanent sets. This may arise from similar causes to those of exostosis, only perhaps the inflammatory action is not so chronic. An alveolar abscess, or any foreign substances close to or perforating the cementum, so as to irritate the periosteum, may give rise to it. The pressure of the erupting crown of a neighbouring tooth may also cause it, as in the case of second molar roots pressed upon by an erupting wisdom tooth. Cases are recorded in which the cause was obscure, tooth after tooth being shed with apparently sound crowns, the roots of which showed all the absorption-signs of temporary teeth when shed.

The symptoms are obvious loosening of the teeth, with more or less tenderness. Treatment is usually hopeless.

13. **Pulp, Diseases of the.**—These are mostly phases or results of inflammatory action.

(*a*) *Hyperæmia.*—This is generally due to the loss through caries of the protection which healthy tooth-tissue affords against the thermal, chemical, and mechanical irritation of substances in the mouth. Metal fillings, being thermal conductors, are sometimes the cause of this condition.

The symptoms vary from mere discomfort, to sharp pain on taking hot and cold things. Acids and sweets produce similar effects.

TREATMENT.—The best treatment for this condition is to apply carbolised resin on cotton wool until the tooth can be stopped.

(*b*) *Acute inflammation.*—Acute inflammation of the dental pulp is the result of further progress of decay, so that the nerve-pulp is almost, if not quite, laid bare; at any rate the softened dentine probably extends to it. Metal fillings will also cause it—any filling, in fact, put in incautiously near to an exposed pulp. It frequently ends in death of the tooth because of the strangulation which the bony walls of the pulp-chamber produce on the congested tissue. A sharp throbbing pain, worse when the head is low, consequently at night, is characteristic. The tooth is generally not tender.

TREATMENT.—In the early stage a purge is necessary. A leech applied on the gum might possibly stop the pain, and save the nerve. Probably it is just as well to devitalise the nerve at once with arsenic; but this should only be done by the dental surgeon.

(*c*) *Chronic inflammation* has similar causes involved in its production. They act less acutely, and hence the results are different. The pain comes on at intervals, and is only acute when the pulp is actively irritated by food or pressure. A pulp so inflamed by exposure in a carious cavity gradually ulcerates away. Under a filling, or when not actually exposed by caries, it sometimes shrivels and dies.

(*d*) *Hypertrophy or polypus of the pulp* is one result of chronic inflammation. The congested pulp swelling into the carious cavity is irritated into exuberant growth by the sharp edges of the opening through which it protrudes.

(*e*) *Calcification* is occasionally due to inflammatory action, but cannot always be traced to it. It may take the form of general calcareous degeneration, or occur only as bony nodules in teeth often apparently quite sound. These nodules may give rise to neuralgic pains, the cause being suspected only when other possible causes are excluded. Additional testimony is sometimes afforded by the strong conviction on the part of the patient of the identity of the offending tooth. It is possible that the gouty or rheumatic diathesis may give rise to this trouble.

14. **Syphilitic Teeth.**—We are indebted to Mr. Hutchinson for the interesting discovery that children who inherit syphilis are liable to characteristic deformity of certain teeth, and that this is not infrequently associated with specific interstitial inflammation of the cornea. Syphilitic teeth are small, narrow, more or less pointed, and usually of a dirty-grey colour. Both the temporary and permanent sets may be affected; but it is the front teeth of the latter that exhibit the characteristic and most marked deformity. The lower incisors are peggy and pointed; those of the upper jaw are narrowed, instead of expanded towards the cutting edge; and the centrals frequently have a crescentic notch. The other irregularities of shape in the teeth may arise or be closely imitated, where there is no specific taint, but the crescentic notch in the contracted cutting edge of the superior permanent central incisor is believed to be diagnostic of inherited syphilis. As such, it is of great value to the physician in deciding on the nature of doubtful symptoms which may, or may not, have an hereditary syphilitic origin. Mr. Hutchinson considers that these malformations of teeth are occasioned by specific stomatitis. But perverted form and nutrition need not be inflammatory in origin; and it may be doubted whether such action arises in these cases. The teeth are dermal organs, and upon the skin syphilis inflicts some of its chief injuries, which need not be inflammatory.

15. **Toothache.**—The term 'toothache' can scarcely be used with critical accuracy, as it is popularly applied to any pain in or immediately round a tooth, without distinction as to its cause or character. Such pain may be produced by many conditions, the commonest of which is dental caries, with or without exposure of the pulp. But other influences may induce pain, scarcely to be distinguished from that of tooth-decay. Among these causes may be enumerated *impaction of the wisdom-teeth*, especially the lower; *inflammation of the tooth-pulp* and *periosteum*; *rheumatism*; *deposit of secondary dentine* in the pulp-chamber; and *exostosis.*

Excepting where pain is very severe, and of such a character as to assert its exact locality, it is not infrequently referred to a position, and to a particular tooth, other than the one affected. Where this is the case, it is mostly *anterior* to the locality of its origin; and is often only discovered by roughly manipulating or sharply tapping the teeth.

Toothache dependent upon *dental caries* usually arises when the decay approaches the tooth-pulp, and is the result of inflammation of it. The tooth-pulp consists very largely of nerves, and is closely boxed up within unyielding walls, so that its swelling gives rise to great internal pressure; hence the pain is of a very severe and distressing character. Inflammation frequently yields to complete or partial suppuration of the pulp; the escape of the matter being attended with marked relief. This may arise either from the breaking down of the external carious wall of the tooth, or from its finding vent through the orifice at the apex of its fang; and so constituting an alveolar abscess, which ultimately bursts, either as a gumboil within the mouth, or by a fistulous opening upon the cheek.

The *impaction of a wisdom-tooth* produces a form of toothache which is usually of a dull character, and gives a sense of tension and restraint. It arises from want of room for the coming tooth, the growth of which produces pressure on the contiguous structures. The pain often wanders along the whole jaw, and may appear to be especially associated with any other tooth on that side. Occasionally the second molar becomes so eroded, through absorption of its posterior fang by the pressure of the wisdom-tooth, as to cause inflammation of its pulp, in which case there may be acute toothache and loosening of the tooth.

Inflammation of the tooth-pulp may sometimes occur spontaneously, and thus give rise to pain.

Inflammation of the periosteum around any particular tooth, the result of disease or any external violence, may have the same effect. It is said also that the inflammation of the fibrous tissues round the teeth may be of a rheumatic character, but of this there is no positive evidence. It may, however, arise from syphilitic periostitis, and from the administration of mercury when pushed to the verge of salivation. Iodide of potassium has sometimes a like effect.

Secondary dentine and *exostosis* may also be associated with toothache, which is frequently of a neuralgic and wandering character, so that it is often difficult to fix upon the offending tooth. It is difficult to say whether the pain results from the pressure of the adventitious growth, or whether they are both the result of some sub-inflammatory condition.

TREATMENT.—The treatment of toothache consists in attention to the general health; in local applications; and in extraction of the offending organ. Tonics, especially quinine, are often useful where the pains are of an inconstant and neuralgic character. Food and stimulants, especially wine, would also give relief in such cases, where the patient is below par. When the toothache arises from caries, great relief is experienced in the early stages by the application of creasote or carbolic acid. Where pus is pent up within the pulp-cavity it should be evacuated, either by opening the pulp-cavity from above, or by drilling the tooth.

Where the pain arises from impaction of wisdom-teeth, relief from pressure must be given by extraction. If the wisdom-tooth cannot itself be got at, the second molar should be taken out. In all cases where the pain has become excessive and intractable, removal of the tooth is the only remedy.

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TEETH, Grinding of. — Automatic movements of the mouth are common to many diseases, especially in young subjects. In cerebral disorders in children we often notice a vertical movement of the jaw, as if the patient were chewing. At other times the movement is a lateral one, and the teeth are ground together, so as to give rise to a hard unpleasant grating sound. This symptom is not, however, necessarily dependent upon disease of the brain, nor is it peculiar to early life. Grinding of the teeth may be observed at all ages, and in many different complaints. It is frequently spoken of as a symptom of worms, and is, indeed, often present when the alimentary canal is infested with these parasites; but the symptom is in such cases quite independent of the worms, and is to be ascribed merely to the intestinal derangement which is the essence of the disease, the presence of worms being merely an accidental complication. Disordered bowels are by far the most common cause of grinding of the teeth; and therefore, with the exception of cerebral disease, this symptom is almost confined to such disorders as are accompanied by derangements of the alimentary canal. Thus children with tuberculosis often grate their teeth together with painful persistency; but in this disease an acid condition of the contents of the stomach and bowels is an almost invariable complication. Again, in rheumatism and gout, where there is the same tendency to acid fermentation of food, grinding of the teeth is a common symptom in the adult.

The movement of the jaw occurs, as a rule, independently of the will, and is seldom noticed except during sleep. Sometimes, however, children will grind their teeth voluntarily, and apparently with full consciousness of what they are doing. Such cases are, however, rare.

The *treatment* of teeth-grinding consists in the correction or removal, if possible, of the condition upon which it depends.

EUSTACE SMITH.

TEETHING, Disorders of. — *See* DENTITION, Disorders of.

TELANGEIECTASIS (τῆλε, far; ἀγγεῖον, a blood-vessel; and ἔκτασις, a dilatation).—Aneurysm by anastomosis. *See* ANEURYSM; and TUMOURS.

TELESE, in Italy (Benevento).—Sulphur waters. *See* MINERAL WATERS.

TEMPERAMENT. — SYNON.: Fr. *Tempérament*; Ger. *Körperanlage.*—This term denotes the correlation of grouped differences existing among men, in respect of physical structure and conformation, with differences of functional activity, of mental endowment and disposition, and of affection by external circumstances.

The early writers on medicine, recognising the facts that each individual man is different from all other men in physical appearance; that, again, in every man are found qualities proper to himself, inherent and indestructible; that, again, on a review of many men a constant association of certain qualities with certain variations in physical appearance may be observed, proceeded to make generalisations, tending to the doctrine of temperaments. This doctrine, as fully set forth by Galen, established nine kinds of temperament. First, the *balanced* temperament (*εὐκρασία*, *temperies*), consisting in a mixture of different qualities in such due proportion that none is in excess. Next, four temperaments of simple excess or default—the *hot*, the *cold*, the *moist*, and the *dry*; and then four mixtures of these—the *hot and dry*, the *hot and moist*, the *cold and dry*, the *cold and moist*. Subsequently, under the influence of the humoral pathology, temperaments were classified as *sanguineous*, *bilious*, *phlegmatic*, or *melancholic*, according as the heart, the liver, the head, or the spleen was supposed to be predominant in modifying the humours of the body. More recent writers have again abridged the list, and have given its categories a new interpretation. They mostly acknowledge but three temperaments—the *sanguine*, the *nervous*, and the *lymphatic.* The balanced temperament is not included, because no individual of such perfect structure exists. But it is equally true that the descriptions by which the other terms are defined represent either individuals used as types, and therefore correspond fully only to one or very few of the units of large genera, or are constructive types corresponding to no single existence.

Regarding the method of classification as wholly artificial, yet without denying its usefulness, we propose to preface the generally accepted description of the three temperaments above mentioned by a brief analysis of Galen's picture of the εὔκρᾱτος. The thoroughly tempered human being is in his bodily constitution exactly midway between slimness and stoutness, between softness and hardness, between hot and cold. In his mental constitution he exhibits the exact mean between rashness and timidity, between sluggishness and precipitancy, between the sweetness of pity and the bitterness of hatred. Such a one is brave, affectionate at home, and abroad discreet. To these essentials are added, of necessity, temperance in eating and drinking, perfect digestion and assimilation of food, physical and psychical energies without a flaw, the best powers of feeling, the best powers of movement, a clear skin, a good breath. He is neither too much given to sleep nor too wakeful, is midway between baldness and hairiness, between darkness and fairness of complexion. When a child he has reddish rather than black hair, in adult life the reverse.

The three modern categories correspond fairly to Galen's mixed temperaments: the sanguine to the hot and moist, the nervous to the hot and dry, the lymphatic to the mixtures of cold with moist or dry.

The Sanguine Temperament.—Persons belonging to this group are described as being ruddy and bright of complexion, as having strong and salient muscles, a relatively large chest, and a relatively small head. The play of their senses, the determinations of their will, the responses of their muscles to impulses, are energetic and well-directed. Arterial blood abounds in them; their veins are small. The functions of their bodies are rapidly and easily performed. The functions of their minds show a similar vivacity. Rapid thought, quick imagination, brilliant courage, are associated with want of depth and persistence, with elastic forgetfulness even of strong impressions. In illness such people inflame quickly, develop diseases in a complete and regular way, and defervesce quickly, often with well-marked crisis. They are especially liable to gout, acute inflammations, and active hæmorrhages. They are men who dominate their fellows.

The Nervous Temperament. — Herein, as authors tell us, the skin is dark, dull, earthy, or sallow, and is hot and pungent to the touch, instead of being warm and moist. The cranium is large in proportion to the face; the muscles spare and not well-defined; the chest narrow; the circulation languid, with preponderance of the venous system. The face has the lineaments of energy and intensity of thought and feeling; the movements are hasty, abrupt, often violent, in alternation with languor. The affections are violent and persistent, the sexual passions usually very strong. Sensations are intense, far in excess of exciting causes. The mental powers are large and capable of persistent exercise. The bodily organisation favours venous congestion and hæmorrhage, neuralgia, hepatic and intestinal obstructions, and the mental lunacies. Nevertheless, these people are often found to endure long fatigue, privation, and exposure better than the sanguine. They are the people who teach or lead their fellows.

The Lymphatic Temperament.—A heavy ill-proportioned ungainly form of body, large joints, bulky head, large hands, broad flat feet, light or reddish hair, a sallow or pasty complexion, accompany a general slowness and languor of bodily function. The muscles are often large, but their movements are awkward or inaccurately directed; the chest and heart are inadequate in bulk to the rest of the body. With this, there may often be combined much mental firmness, solidity, and constancy—a good judgment if a poor energy. The power of resistance to acute disease is inferior; the tendency to chronic diseases, particularly of strumous and asthenic kinds, is pronounced.

In the sanguine temperament a predominance of blood-making power and of muscular development is asserted. It may, perhaps, be spoken of as the temperament in which the spinal system and the parts directly subordinate thereto are most developed. In the nervous temperament the predominance of the cerebrum is clearly indicated. In the lymphatic temperament, languor or slowness of both nervous and circulatory systems is connected with slowness or default of the general nutrition.

Practically these types comprehend only a part of mankind. If we admit that they can be extended in their application by the recognition of mixtures of them among themselves in various proportions and degrees, we must admit also that there exist, outside of them altogether, numerous correlations of much importance to the physician. Moreover, many of the constituents of temperaments are capable of being changed by age, external circumstances, and habit. New combinations may be introduced by these agencies, or by bodily changes arising in accident or disease. The building anew of a man's temperament by religious enthusiasm, by suffering, by moral control, or by indulgence, is a spectacle daily to be seen and studied. In that analysis of the *κρᾶσις* of the individual which must furnish the interpretation of much of his behaviour in illness, the accurate estimation of many combined influences, native and accessory, has been called the stumbling-block of practice. It may better be called the touchstone of practical skill. That physician does well who carries with him a mental picture of some such perfect human animal as Galen has imagined; and who marks on the diagram, with his patient before him, the lines of original shortcoming, of development, of warp, of injury, of degeneration, so as to arrive at some clear sight of the outcome or resultant of all in the present organisation and reactions of that patient.

William M. Ord.

TEMPERATURE. — Synon.: Fr. *Température*; Ger. *Körperwärme*; *Eigenwärme.*

Introduction.—The human body, like that of all warm-blooded animals, has a heat of its own, which is, to a great extent, independent of the surrounding temperature. As long as the body is in a state of health, the external circumstances must either very materially change, or a change of them must operate for some length of time, before any but a transitory elevation or depression of the blood-heat will occur. But the temperature becomes much more easily altered when the normal action of the nervous system is disturbed, or when, in consequence of disease, or because toxic or infectious substances have been introduced from without, the chemical processes in the body become altered. A change of the blood-heat is often the very first symptom of a disease, and it may occur even before the slightest indisposition is felt by the patient. Hence observations of the temperature may be extremely valuable for diagnosis, and the course of most diseases being accompanied by corresponding alterations of temperature, which in many diseases are quite typical, the great importance of closely watching the course of the temperature becomes evident. Clinical medicine has by the use of thermometry entered on a new phase, having gained the means of a numerical expression for variations of complex states of the system which the practitioner, from the indications of the thermometer, may detect earlier and judge of more correctly than by any other symptom. For an exhaustive account of the changes of temperature which may be observed in health, and especially in disease, the reader may be referred to the classical work of Wunderlich, translated for the New Sydenham Society.

Sources and Regulation of the Body-Heat.—The sources of animal heat must be chiefly sought for in chemical processes, especially oxidation, which are constantly going on in the blood and tissues, above all, as shown by Speck, Zuntz, and others, in the muscles under the influence of the nervous system. To a minor degree various processes of a purely physical nature, such as friction, or the transformation into heat of other forms of energy, themselves the outcome of chemical processes, have also a share in its production. But the generation of heat within the body does not explain the fact of the blood-heat being constantly kept at the same level. This fact presupposes that the amount of heat produced is exactly equalled by the sum-total of the losses of heat which are constantly going on—at the surface of the body by radiation and evaporation, from the lungs by evaporation and by the warming of the colder air taken in at every inspiration, in muscles when mechanical work is done, in the intestinal canal by the warming of ingested cold food or drink, and, lastly, by the dejecta which leave the body. Any disturbance of this equilibrium must be followed either by an increase or by a lowering of the general temperature. But there is another factor, without which the maintenance of this equilibrium, and an equal distribution of the heat throughout the body, would be impossible, namely, the circulation of the blood. By this means a regulation of the loss of heat may be effected whenever required, the blood-supply to the skin varying as the arteries dilate or contract under the influence of the vaso-motor nerves. But not only the losses of heat may be varied, but its production also is capable of being modified, under the influence of the nervous system. Whenever the external temperature would cause too considerable a loss of heat, the peripheral arteries contract, and the circulation becomes slower; heat is thereby retained in the body, but at the same time the heat-producing processes in the muscles are stimulated to increased action, as shown by the quantity of carbonic acid given off being increased. When, on the contrary, the loss of heat on the surface is prevented, as in a very hot room, *e.g.* a hot-air bath, the peripheral arteries dilate; the heart's action becomes accelerated; and a much greater quantity of blood flows through the skin and peripheral parts, the sweat-glands pouring forth an increased quantity of sweat, which, by its evaporation, tends considerably to lower the temperature. At the same time the respiration also is accelerated. Besides the vaso-motor apparatus, there appears, from experiments made by Aronsohn and Sachs, Girard, Isaac Ott, Girard, and Hale White, to exist a centre for the regulation of heat-production in the corpus striatum of the brain, the cortex of which, by voluntary as well as by reflex action, also has its share in the maintenance of the proper heat of the body. Thus a most wonderfully precise reflex-mechanism regulates the heat of the body, by altering the production as well as the loss according to necessity.

TEMPERATURE IN HEALTH.—The heat of the blood is at every moment of life the result of different forces balancing each other, namely, the heat-producing and the heat-destroying processes and influences. So, also, the temperature of a single part of the body results from the heat-production going on within it and its exposure to cooling influences, and is chiefly dependent upon its blood-supply. The heat of the body is, therefore, most variable on the surface, and is lowest in its uncovered parts, especially in the most projecting ones; almost uniform, on the contrary, in the interior, where only slight differences, amounting to a few tenths of a degree, exist. In the lower animals Claude Bernard found the temperature highest in the hepatic veins and the right auricle. The heat of an organ increases when its functional activity is heightened, as, for instance, when the brain, a muscle, or a gland, is stimulated to increased function.

It is necessary for practical purposes to consider chiefly the temperature in the interior, or the blood-heat. The blood-heat is measured, as nearly as possible, by means of the clinical thermometer. *See* THERMOMETER, CLINICAL.

In healthy man the temperature of the body, as measured in the axilla, is about 98·6° F. (37·0° C.) Inside the mouth, underneath the tongue, it is almost the same; whereas in the vagina or rectum it is 0·3° to 0·6° higher. Under special circumstances—for instance, when a considerable cooling of the surface takes place, or when the skin freely perspires—the difference may be somewhat greater, and there may be a difference of 20° between the temperature of exposed parts of the skin and the interior; on the other hand, all parts may be pretty equally warm in the morning in bed, or in a warm room, or when the circulation has been influenced by slight exercise, or by a good meal and a moderate amount of alcohol. Of considerable influence upon the temperature of the surface of the body is the amount of fat in the subcutaneous tissue. In plump children and in very obese adults the surface may be considerably colder than the interior, and in the latter case there generally is yet another and even more effective cause for this difference, namely, weakness of the heart's action.

The temperature of the body is not the same all through the day. Numerous careful observations, of which those of Jürgensen, Liebermeister, and Ogle may be specially mentioned, have shown that the temperature of a healthy person, even when kept entirely at rest in bed, will fluctuate from about 1·8° to 2·3° F. in the course of the twenty-four hours; the mercury standing lowest between 2 A.M. and 6 A.M., and then gradually rising until it reaches the highest point between 5 P.M. and 8 P.M. This rise is mostly not continuous, but becomes somewhat slower, or even interrupted by a slight decrease, in the middle of the day, the afternoon hours showing a more rapid elevation.

This daily fluctuation of the body-heat is a fact of fundamental importance, for it not only takes place in health, but also when, in disease, the whole range of the temperature is either depressed or abnormally elevated. The causes of this daily fluctuation of temperature are not yet fully made out; but this much is certain, that rest and movement, as well as the taking of food, have some share in producing it. Another cause which must not be overlooked, and which was pointed out by Liebermeister, is the force of habit and inheritance.

Race and sex have no influence, to speak of, upon the range of the temperature. Age, on the contrary, has by different observers been found to influence the range as well as the daily fluctuation. In the infant, immediately after its birth, the temperature is slightly higher than later on, its temperature in the rectum having even been found higher than that of the vagina of its mother. A higher range is maintained in the first weeks of life, and there has also been found wanting in infants that steady course of the daily fluctuation which is observed in adults. In children, even somewhat more advanced in age, the temperature is still easily influenced by external changes, and the range of the daily fluctuation is greater. In old age, again, the range is a little higher than in adult life, and here, also, a greater mobility of the temperature under various external causes is observed. The menstrual process, as shown by Goodman, Mrs. Jacobi, and Reinl, causes a slight elevation of temperature, amounting, however, to only a few tenths of a degree in the pre-menstrual period, which goes gradually down again during the flow and after it is over. Pregnancy has no appreciable influence in healthy women. Parturition slightly increases the temperature, evidently by the increased muscular action, an increase which is compensated by a corresponding fall after the birth of the child. If no complications occur, the temperature in the puerperal state generally does not deviate from the normal.

Such, in fact, is the constancy of the body-heat in health, that the general conditions of life, occupation, &c., hardly show any influence upon it, and whenever, by muscular exertion, or by the effect of external heat or cold—as, for instance, by baths of various temperatures —a more considerable deviation from the normal range has for a time been caused, there is a strong tendency in the system to compensate the increase or the loss of heat by a corresponding fall or rise afterwards. This faculty is somewhat altered in disease; and even in those states which are on the borderland of disease, we frequently find a less perfect action of the regulation of the local or general temperature of the body.

Local Changes of Temperature.—Local changes of temperature are brought about by external thermic influences acting locally, or by disease. Local stoppage of the blood-supply or local death lowers the temperature of the part; inflammation, in its first stage, raises it. Considerable local changes of temperature may arise simply from vaso-motor disturbances. Thus, in a paralysed limb the temperature may either be lower or higher than in the corresponding limb of the other side; in hemiplegia the temperature of the paralysed side is frequently found 0·5-1·5° higher than on the normal side Neuralgia is sometimes accompanied by dilatation of the blood-vessels, and a considerable rise of the local temperature; and, as a purely vaso-motor disturbance, local heat and redness of the skin, due to a passing dilatation of blood-vessels, sometimes occur in hysteria.

Changes of the General Temperature.—Of much greater practical importance than local disturbances of the body-heat are changes of the general temperature, such as occur in many diseases, whether of the nature of *depression* or of *elevation.*

1. Depression.—Depression of the general temperature is observed as a consequence of considerable loss of blood; in starvation from any cause; and in the wasting of some chronic diseases, such as cancer of various organs, or in diseases of the brain and spinal cord. In brain-disease, with the symptoms of melancholia, extreme coldness of the surface and lowering of the general temperature occasionally occur. In a case of hæmorrhage into the medulla oblongata, Lemcke observed a temperature as low as 73·4° F. (23° C.) in the rectum twenty-seven hours before death; and extreme loss of heat, though hardly to such a degree, by vaso-motor paralysis and dilatation of the blood-vessels, may be caused by severe injuries to the upper part of the spine. In a very rapid manner a considerable fall of temperature may take place in the collapse sometimes occurring in the course of typhoid fever, but especially in that of acute peritonitis, and of poisoning by various substances. In the collapse of cholera the lowering of the temperature of the axilla may be considerable—a temperature as low as 89·6° F. (32° C.) in the axilla, and even less under the tongue, having been observed, at the same time the temperature of the interior of the body being generally very high, reaching 104° F. (40° C.), and sometimes much more. In peritonitis a low general temperature may be present for days, even if the peritonitis supervene in the course of typhoid fever. With the collapse caused by alcoholic intoxication great depression of the general temperature occurs when the patient is exposed to cold and wet; and in a case of carbolic-acid poisoning, which came under the observation of the writer, the vaginal temperature fell as low as 93·92° F. (34·4° C.) A temperature of 71·6° F. (22° C.) has been observed in sclerema neonatorum.

In chronic diseases of the respiratory organs, not of an inflammatory or tuberculous nature, as well as in chronic heart- or kidney-disease, the temperature is generally found somewhat below normal; and the same is the case in chronic nephritis, more especially in those cases accompanied by general dropsy. In cases of the latter kind we even sometimes see a febrile temperature, caused, for instance, by tubercular disease of the lungs, become considerably abated, if not entirely reversed, when chronic kidney-disease supervenes; as also when intestinal ulceration becomes more prominent, or leads to peritonitis. From some observations of the writer of this article, it would seem as if intracranial disease, such as softening or tumour, arising during the course of a febrile disorder, *e.g.* pulmonary phthisis, may not only disturb the regularity of the febrile temperature-changes, but, by a kind of inhibitory action, entirely suppress the febrile elevation of temperature.

2. **Elevation.**—Elevation of the general temperature, as part of the febrile process, is the most prominent symptom in most diseases of an infectious origin, with or without inflammation. In both an increased production of heat, no less than a disturbance of the regulation of the temperature, is the effect of the presence in the blood of some foreign substance, acting injuriously on the nervous system, and causing altered chemical processes. Modern research gives the most prominent part in these actions to organised bodies (fungi, bacteria), which, in themselves, or, more probably, by chemical products of their own life-changes, or by the changes which they cause in the fluids of the body, are assumed to be the cause of the febrile process, and thus of the increased temperature.

Some such substances, belonging chemically to the albuminoids and acting as ferments, have recently been extracted from pure cultures of the yeast-fungus by Roussy, and of various bacteria by Koch (tuberculin), Buchner, and others. *See* Fever.

The proper balance of the heat-forming and heat-destroying processes may also be disturbed by other influences acting upon, and by primary diseases of, the nervous system. When the body is subjected to external cold after it has been fatigued by exercise and already cooled by perspiration—if, for instance, a cold bath were taken under such circumstances, a rigor, with rapid rising of the temperature, may follow; but, no local disease becoming developed, the temperature quickly goes down again amid profuse perspiration, and the whole attack may be over. Or a disturbance of the heat-regulating functions of the nervous system may be caused by the irritation of some nerve-filaments, as by a gall-stone passing the biliary duct, or a stone passing the ureter or the urethra, and a febrile attack will follow. The rigor, leading to a high fever of an evanescent character, which may follow the introduction of a catheter (urethral fever), sometimes belongs to the same group of cases. But generally, in cases of this kind, the nervous system is already in an abnormal state through the previous disease of the kidneys or bladder. The functions of the nervous system may further be deranged by injury; and a rise of temperature has not only been observed in injuries to the brain, but, in a most excessive degree, sometimes after injury of the cervical part of the spinal cord, when temperatures of 110° to 111° F. (43·3° to 44° C.) have been observed (B. Brodie, H. Weber, Teale, and others). In tetanus a very high temperature may occur, rising still higher a little after death; as much as 112·55° F. (44·75° C.) was reached in a case observed by Wunderlich. An alteration of the heat-regulating functions of the nervous system may be brought about by a considerable external heat acting upon the body, especially when combined with moisture of the air. In cases of sunstroke or heat-stroke, it is quite common to see the temperature of the body rise to 108° F. (42·2° C.) and more; and it would seem probable that a febrile elevation of temperature, if going on unchecked for a considerable time, by causing exhaustion of the nervous system, may lead to hyperpyrexia. Thus it is not very uncommon to see the temperature rise excessively in infectious diseases, especially scarlatina, towards the close of life (*proagonic hyperpyrexia*); and the temperature may, in such cases, even rise a little more immediately after death. This is due to the losses of heat being greatly reduced after the stoppage of the circulation, the heat-production going on in the interior for a time; and the gradual failure of the circulation probably also takes a great share among the causes of a proagonic hyperpyrexia.

Hyperpyrexia sometimes comes on in the convalescence from acute rheumatism, even after the fever has entirely subsided, and when the patient is on the point of being discharged from the hospital. An excessive rise has occurred and caused death in severe cases of hysteria; and in hysterical patients hyperpyrexia has occasionally been observed without any of the symptoms which in other cases usually accompany so grave a phenomenon. Cases of this kind are extremely suspicious, and in some of them it was discovered how this hyperpyrexia was simulated. Thus a patient had driven up the mercury by rubbing the bulb of the thermometer between the folds of her night-dress; whilst in other cases the high elevation of the mercury had been brought about by means of a hot poultice, or by the patient having lowered the top of the instrument, so that the column of mercury began moving by its own weight. This, however, is not possible with a thermometer of the thin bore which English thermometers now generally have. A very high temperature, to which the pulse and respiration and the other symptoms do not correspond, must always arouse a suspicion that the rise of the mercury has been artificially produced, and the verification will be easy if the physician carefully watch the mercury as it rises, or by taking the temperature in the rectum or vagina.

The very important part which the nervous system plays in regulating the blood-heat is also seen in the great liability of the temperature easily to deviate from the normal range during convalescence from acute disease, when the weakness of the nervous system, brought on by the previous illness, will show itself in this no less than in other alterations of function. This can frequently be observed in convalescence, not only from the specific fevers, but also from pneumonia and other acute febrile diseases, when trifling external influences may cause a considerable rise of the temperature, which, however, is generally of short duration only, but which, in the case of specific fevers, may cause apprehension lest a relapse be coming on. In a somewhat different manner, and more lasting, a slight sub-febrile elevation of temperature may be observed in the convalescence from acute rheumatism, where it may persist for weeks without any joint or heart symptoms being present.

Significance of Abnormal Temperature for Diagnosis and Prognosis.—The maintenance of the heat of the body at a certain range being so insured, any deviation of the general temperature from the normal standard, however slight in degree, and unless of a very transient nature or brought on by evident external causes, is to be taken as a sign of disease. Such deviation may be of a variable degree, along with symptoms which, in part, are the consequence of the abnormal temperature, such as an abnormal rate of pulse and respiration, and nervous symptoms. The whole range of deviation within which life can be maintained is comprised between 90° F. (32·3° C.) and 110° F. (43·4° C.) A temperature approaching either end of this range indicates a condition of extreme danger, which is already great with a temperature of 95° F. (35° C.), or beyond 106·5° F. (41·5° C.) With reference to the general condition of a patient who presents an abnormal temperature, a few distinctions may be conveniently tabulated.

(1) *Temperature below the normal*:—

(*a*) Temperature of collapse, below 97° F. (36·2° C.)

(*b*) Subnormal temperature, 97–98° F. (36·2–36·7° C.)

(2) *Normal temperature*: 98·0–99·5° F. (36·7–37·5° C.)

(3) *Temperature above the normal*:—

(*a*) Sub-febrile temperature, 99·5–100·5° F. (37·5–38·05° C.)

(*b*) Febrile temperature of moderate degree, 100·5–102° F. (38·05–38·88° C.), morning; 102·2–103° F. (39–39·44° C.), evening.

(*c*) Febrile temperature of high degree, 102·5° F. (39·2° C.), and more in the morning; 105–106° F. (40·6–41·1° C.) in the evening.

(*d*) Hyperpyrexia, 105·8–107·5° F. (41–42° C.) and more. Extremely dangerous.

Single Observations.—Near the ends of this scale a single observation of the temperature of a patient may at once decide the prognosis. Thus a temperature below 93° F. (33·88° C.) or above 108° F. (42·22° C.) is almost always fatal, although cases have recovered by active treatment in which the latter point has been exceeded by several degrees. No less valuable may single observations be for diagnosis, chiefly in a general way, in showing that there is disease when, perhaps, no other symptom points to it, but also for the diagnosis of a special disease in some instances. Where there are other symptoms of disease, the discovery of an abnormally high or a febrile temperature may at once give quite a different aspect to a case, as, for instance, when a patient who has been suffering for some time from a troublesome cough without expectoration, but in whom the most careful examination of the chest could not detect any lung disease, is found to have pyrexia. The suspicion that there is commencing phthisis may thereby be at once confirmed, or aroused for the first time. Or, again, in a case where the patient simply complains of dyspepsia and lassitude, the thermometer may give a degree of heat which would not have been expected either from the looks of the patient or from the temperature of his hands or chest, and the attention may thereby at once be directed to the possibility of the case being one of typhoid or some other specific fever. One reservation must be made with regard to single observations in patients who have not been kept at rest for some time before, for example, in patients who have walked to the physician's house, or who had to undergo a journey to the hospital. In such cases the temperature may be somewhat altered by the fatigue; and it is quite common to find the first temperature in a patient, immediately after his admission into the hospital, considerably higher than after a few hours' rest, or, if he have been exposed to cold, much lower than what would otherwise correspond to his condition.

Systematic Series of Observations. But of much greater value than isolated observations of temperature is the regular and continued watching of the course which the temperature takes in a disease. Many diseases present a deviation from the normal temperature showing a typical course as regards the duration, as well as the daily fluctuations, of the abnormal temperature. The course of its temperature being part of the natural history of a disease, the study of this is of great importance for diagnosis.

Types of Pyrexia.—First, it is *the mode of rising* of the temperature which varies, and by which some diseases may be distinguished. In some diseases a contraction of the peripheral arteries takes place at the onset, which, by diminishing the peripheral circulation and the giving off of heat, leads to a rapid rise of the internal temperature, and is accompanied by a sensation of cold. In pneumonia, therefore, and other diseases commencing with a rigor, the temperature rises rapidly and continuously to a height of 104° F. (40° C.) or more; whereas diseases with a more gradual beginning show simply a slow elevation of the normal range, both morning and evening temperatures becoming gradually higher, the usual daily fluctuation being maintained. Thus, in the first few days of typhoid fever the temperature rises every day about 2° F.; but the temperature going down again in the morning by about 1° F., the maximum of about 105° F. is only attained on the fifth or sixth day.

At *the height* of a disease the temperature may fluctuate round an average temperature of about 103° F. (39·5° C.) or more, whilst it shows the same daily course as in health, that is, being lowest in the morning and highest in the evening. The range of this daily fluctuation may, however, differ considerably in different diseases; and according to the extent of the daily fluctuation three types may be distinguished. When the daily fluctuation of an elevated temperature shows only the normal difference, or even a smaller difference, between the morning and evening temperatures, we speak of *continuous*, or, more correctly, *sub-continuous* pyrexia; when the difference is greater than the normal, the remission having a tendency to a low temperature, and the exacerbation, on the contrary, to a considerable rise, the pyrexia is called *remittent*; and, thirdly, when the remissions reach the normal, or recede even below it, we have the *intermittent* type of pyrexia.

A *continuous* elevation of temperature is observed soon after the commencement of a disease, and during its height.

Considerable *remissions*, or even *intermissions*, of the febrile temperature are principally observed in the decline of some acute diseases, and in chronic inflammatory diseases, especially of a tubercular nature, or in chronic syphilitic affections, in pernicious anæmia and leukæmia, as well as in some cases of lymphadenoma (Hodgkin's disease), the remissions generally becoming more marked as the exhaustion of the patient increases.

The *intermittent* type of pyrexia is most typically shown in malarial diseases, in which the elevation of temperature may follow a quotidian, tertian, or quartan type. The same also sometimes occurs in chronic tubercular disease of the lungs and in pyæmia. Pyrexia of a remittent type may present a peculiarity which is worthy of note, as being of some diagnostic value. Whereas in the great majority of cases the daily fluctuation follows the rule of health, the exacerbation taking place in the evening, we sometimes meet with cases where this order is reversed, the rise taking place in the morning, and the remission occurring in the evening. This 'inverse type,' as Traube called it, of the daily fluctuation of a febrile temperature has been observed in some rare instances in typhoid fever; more frequently in cases of chronic lung-disease. In doubtful cases of inflammation of the lungs it has some significance as to the disease belonging to the class of phthisis.

Slight deviations in the maximum daily rise of a febrile temperature occur sometimes in this way, that the height is reached in the middle of the day, or that the exacerbation takes place in the night, or that two or more considerable elevations, instead of one only, take place in the twenty-four hours. Such occurrences, which have been observed in typhoid fever and in phthisis, can, of course, only be found out by the observations of the temperature being repeated with sufficient frequency. A more frequent application of the thermometer will also be necessary in some cases of ague, where the attacks are not well marked, or occur in the night, in order correctly to judge of the case.

The *decline* of the elevation of temperature, at the termination of a disease, may be gradual, the daily fluctuation, however, taking place as usual; or it may be rapid, by a continuous sinking of the temperature to, or somewhat below, the normal, in the course of from twelve to thirty-six hours, or even in six to eight hours, as in relapsing fever. The latter mode of termination of a fever is called *crisis*, whereas the former is designated *lysis*. A crisis may sometimes be accompanied by symptoms of collapse, and, in some rare instances, by acute delirium, which, however, generally passes off within a day or two, and is not of bad omen provided the general condition of the patient remain good. Symptoms of this kind, as well as a more considerable elevation of the temperature just previously to its fall, or a great irregularity in the course of the temperature preceding it, may be called *perturbatio critica*. It would appear that diseases caused by the action in the system of some foreign substance—as, for instance, some infective agent, its action being of a limited duration—have a tendency to a critical defervescence. Diseases, on the contrary, in which an organ has become materially altered, as by an injury, or by some infection either primarily or, in the course of a chronic disease, by the duration of the morbid action, or by some supervening secondary infection, show a slow decline of the pyrexia, with a tendency to a remittent type. The repair of the damaged structures taking some time, the decline of the pyrexia is slow, and the defervescence by lysis. Examples of the former mode of defervescence are furnished by acute pneumonia, erysipelas, typhus, relapsing fever, and measles when not complicated by more serious inflammation; the latter type is shown by typhoid fever, in which the specific process produces deep alterations in the glandular structures of the intestine, which persist for some time after it has terminated. The ancient physicians believed that a crisis took place on certain days in particular, as, for instance, the seventh day of an illness; but more extended experience, gained by means of the thermometer, has shown that, although a change or a termination of a disease take place at a certain definite period, the latter is not bound to one particular day. *See* Crisis.

Any *irregularity of the course* of the temperature in a disease in which, as a rule, it runs a very regular and definite course, is indicative of some disturbance or complication, and its early detection is therefore important for diagnosis, no less than for prognosis and treatment.

On *the approach of death* the temperature in many cases gradually sinks; but instances are not of rare occurrence in which, on the contrary, especially in diseases with high fever, a continuous rising takes place towards the fatal termination, reaching sometimes hyperpyretic degrees.

In *convalescence* the temperature is more easily influenced by external causes, as well as by internal changes, and the approach of a relapse or complication being at once indicated by a rise of temperature, the continuance of regular thermometrical observations in the first period of convalescence is of very great importance; the more so, as convalescents are sometimes not sensible to changes, which at first only show themselves in an alteration of the temperature.

Treatment.—Abnormal states of temperature ought not, as a rule, to be considered as objects of treatment by themselves, all the concomitant symptoms, in fact the whole state of the patient, having to be taken into consideration, in order properly to treat a case of febrile disease. But there are exceptional cases in which the state of the temperature at once urgently requires a symptomatic treatment. Such are, for instance, cases of *hyperpyrexia* in sunstroke or heat-stroke, in which the most energetic means ought at once to be applied to reduce the temperature. As the experience of American physicians has shown, life may in such cases sometimes be saved by perseveringly rubbing the surface of the body with large pieces of ice, using at the same time stimulants by the rectum or subcutaneously. A rapid abstraction of heat by rubbing with ice, or cold bathing with affusions, may also be the only means of saving a patient in whom, in the course of acute rheumatism, hyperpyrexia has set in; and a case published by the late Dr. Wilson Fox, in which the temperature reached 110° F. in the rectum, is very instructive in showing that external cooling may be successful, when even very large doses of quinine (120 grains had been given in six hours) had been administered without effect. The same plan must be followed in hyperpyrexia occurring in the course of other diseases. Complications, such as pneumonia, do not contra-indicate this treatment, the success of which is, however, dependent upon the possibility of rousing the nervous system, and upon the circulation remaining sufficiently active.

An *abnormally low temperature* requires the external application of heat, which will be materially assisted by warm stimulating drinks or injections, using eventually subcutaneous injections of ether or of tincture of musk, or intravenous or subcutaneous injection of a 0·6 per cent. solution of chloride of sodium in water, to stimulate the action of the heart, and to increase the blood-pressure. *See* Shock.

Apart from such exceptional cases, the treatment of the abnormal states of the temperature must be subordinated to the general treatment of the case. In many cases the abnormal temperature being dependent upon some local cause, the removal of the latter will make the abnormal temperature also disappear, or at least reduce it—an experience with which surgeons are quite familiar.

Rise of temperature being, however, the most appreciable and a most important symptom of *pyrexia*, which, by weakening the heart's action, by lowering blood-pressure, and in other ways, may of itself lead to serious consequences, it would appear advisable in many cases of protracted febrile disease, besides the general or special treatment which the case requires, to treat the febrile temperature symptomatically. And an overwhelming experience has actually shown that the course of the specific fevers, such as typhus, typhoid, scarlatina, although it cannot be cut short, can yet materially be influenced, by measures the primary object of which originally was to keep the febrile temperature artificially down, by means of cold baths or wet packing, or by antipyretic medicines. In rehabilitating the cold-water treatment of fevers, which already in the hands of J. Currie had been so successful, E. Brand, Jürgensen, Liebermeister, and their followers started from the idea that the increased blood-heat ought to be combated; and Liebermeister, than whom few physicians have more practical experience in these matters, laid down as the principle to be followed in the antipyretic treatment of fevers, to increase the remissions that normally take place in the daily fluctuation of temperature, and to prolong them as much as possible. Comparative experiments having shown that external cooling by baths, as well as antipyretic medicines, are of greater effect on the temperature at those times of the day and night when it spontaneously has a tendency to decline, these periods were declared the most favourable for the employment of antipyretic measures, necessitating their least frequent repetition. Others have not laid so much weight on the normal daily fluctuations of febrile heat, but have used the bath whenever the temperature rose to a certain point, say 102·2° F. (39·0° C.) or 103° F. (39·5° C.), obtaining in this way equally favourable results, though, perhaps, with more inconvenience to the patients. More extensive experience has, however, shown that lowering the febrile temperature in itself—which at present, by using one or the other of the antipyretic medicines which modern chemistry supplies in such variety and profusion, can be accomplished to a very high degree—does not produce the same good effect on the whole condition of the patient, or so favourably influence mortality as when brought about by cold bathing or other methods of external cooling. It therefore appears very probable that the beneficial action of the cooling treatment by these external means is due not so much to the reduction of the temperature, as to their powerful influence on the circulation and on the tone of the nervous system. So there may, perhaps, after all, be no reason to feel disappointed at the very transient effect which even a very cold bath has in a case of high fever, and which, as far as mere reduction of temperature is concerned, makes its action appear much inferior to that of antipyretic medicines. For troublesome as it may be for the patient, as well as for his attendants, to repeat the external cooling over and over again in the course of a day, it may yet be this very repetition of the bath, with all its effects, which is of essential importance.

The theory from which antipyretic treatment originally started—that pyrexial elevation of temperature is an unmixed evil—is becoming more and more modified as the conviction is gaining ground that a process like the febrile reaction of the system following upon various external influences, which was, no doubt, gradually acquired through evolution, must be of some advantage to its possessor, if it be only this—that by the increased chemical action which goes on at a higher temperature, abnormal and noxious products of tissue-change and of the life-process of infectious germs will be more rapidly destroyed and cast out of the body. But it would certainly be a step in the wrong direction if such considerations were to lead to giving up all antipyretic measures. On the contrary, experience teaches that it is very important not to wait in a case with continuous high temperature until symptoms of failure of the heart's action—a weak pulse, cold extremities, cyanosis and congestion of the lungs, and muttering delirium—show themselves, but to try to prevent these symptoms by at once resorting to external cooling. Patients treated early on this principle will be found much less frequently to pass into that state, to sleep more soundly, and to retain their appetite, bed-sores and other serious complications being of much rarer occurrence; and it has been established that the mortality in specific fevers has by the cold-water treatment been very considerably diminished, and that convalescence also is quicker than in cases treated on a purely expectant plan. If consistently carried through, the good effects of such treatment mostly show themselves in a few days, not only in the whole condition of the patient, but also in the effect of successive baths on the temperature becoming greater and more lasting, so that the number of baths, as required by a certain height of temperature, becomes less every day.

As regards the methods of external cooling, by far the most effective means are cold baths from 60° to 70° F. (15° to 20° C.), and about ten minutes' duration. More agreeable to the patient are baths of about 95° F. (35° C.), gradually cooled down by the addition of cold water to 70° F. (20° C.), or less, as recommended by von Ziemssen, but their duration must be longer to have the same effect as the former. Riess tried prolonged immersions in warm water of 90° F. (32° C.), but, although acting very powerfully on the temperature, the general effect of such permanent baths is inferior to that of repeated short cold baths. Cold wet-packing is less effectual, but may replace baths in special cases, and when they cannot be given. *See* HYDROTHERAPEUTICS; and COLD, Therapeutics of.

Antipyretic medicines may sparingly be used in order to prolong the effect of a bath on the temperature in cases of very high and persistent fever, but principally with a view to allay some of the troublesome symptoms accompanying pyrexia, especially the headache, the feeling of heat, and uneasiness. For a long time sulphate of quinine had been the only reliable antipyretic drug, but now we possess a great number of chemical preparations, which are much more powerful in reducing a febrile temperature and subduing some of the other symptoms of fever than anything before known. But it ought never to be lost sight of that these preparations, foremost among which stands phenazone, although in individual cases they may be of considerable service, are substances whose effects on the tissues of the body, and especially on the nervous system, are as yet but very imperfectly known, and that a routine treatment of elevated temperature with their aid is much to be deprecated, and cannot compare in innocuity and results with even a routine treatment with cold water, which, it need hardly be said, must also be carefully adapted to the requirements of the case and the individuality of the patient.

C. G. H. Bäumler.

TENDERNESS.—This word, in relation to medical and surgical practice, usually implies that pain, in various degrees and of different kinds, is elicited by pressure, or in some instances by percussion, as distinguished from the sensation which is felt spontaneously by the patient. The term might conveniently be made to include all painful sensations elicited by any physical disturbance of a part, as, for instance, the passive movement of a joint, or the pressure of its surfaces against each other. The like observation applies to any irritation of the mouth or throat, when these parts are the seat of disease accompanied by tenderness; as well as to more internal mucous surfaces, such as the stomach or bladder.

Tenderness is a symptom often of great importance, and it claims the careful attention of the practitioner. It is often present when there is no complaint of pain on the part of the patient; while, on the other hand, it is by no means a necessary accompaniment of spontaneous pain; its very absence is frequently of much consequence in diagnosis. In an investigation for the purpose of eliciting tenderness, much care is required, especially in certain cases; and the examination should be made with gentleness and discretion, so as not to give the patient unnecessary pain, or to produce other effects, which might prove serious in some instances. It may be that only a slight touch can be borne, but pressure may be gradually increased, if necessary, until tenderness is produced; it must be noted what degree of pressure is needed to cause the sensation. The observer must thus endeavour to fix upon the structure in which the tenderness is located, and to determine whether it is superficial or more or less deep, as well as to measure the intensity of the feeling. Its limitation in extent must also be determined. The patient can often give useful information as to the exact character of the sensation produced. Care, however, is necessary to guard against being misled by malingerers, hysterical persons, or those who have imaginary ailments; and also not to mistake tenderness for mere hyperæsthesia of the skin. For this purpose it is of much help, among other points, to watch the patient's expression of countenance whilst pressure is being made. Hysterical patients may seem to suffer acutely when slight pressure is made; but if this be gradually increased, while their attention is diverted by conversation, it is found that the suffering is not real. It must also be remembered that some persons are much more sensitive to physical disturbances than others.

Value in Diagnosis.—Without attempting to treat the subject exhaustively, a few hints may be offered as to the diagnostic indications of tenderness, and the more prominent diseases and conditions in connexion with which the presence and degree of this symptom may give useful information.

1. When pain is complained of, the presence or absence of tenderness, and its degree, may be of signal value in diagnosing the class of painful sensations to which it belongs. For instance, it may be affirmed, as a general rule, that the pain of inflammation is accompanied with tenderness, and especially so if the condition is superficial, has ended in suppuration, or involves definite nerves. On the other hand, a purely neuralgic pain is on the whole free from tenderness, and is not uncommonly relieved by pressure, although there are certain localised 'tender points' in some forms of this complaint, which are also of significance. Hence, when pain is evidently associated with a particular nerve or nerves, pressure may determine whether they are actually involved in some inflammatory mischief, or merely functionally disordered. Actual neuritis gives rise to marked tenderness. Again, the pain of muscular rheumatism, when not inflammatory, is often relieved by pressure; while spasmodic muscular pains are usually thus greatly alleviated, so that patients of their own accord press upon the affected part. In this way a very obvious and decided distinction is frequently afforded between spasmodic and inflammatory conditions involving the abdominal structures. Further, in connexion with tumours and growths, those which are of a malignant nature are often accompanied by pain and tenderness, while those which are benignant may be said to be, as a class, free from such symptoms. Marked tenderness may be an important sign of destructive changes, such as those which occur in some diseases of joints, or as a result of the pressure of an aneurysm or other tumour, where there is at the same time spontaneous pain. Very limited and obvious tenderness may indicate the seat of a foreign body, lodged in the soft parts or irritating them, especially if it should be pointed, as, for instance, a needle. Localised tenderness on percussion is regarded as an important symptom in the diagnosis of cerebral tumour.

2. It must be remembered, in the next place, that tenderness may be a valuable diagnostic sign, when there is no complaint of pain on the part of the patient. For example, it may reveal joint-disease, not previously known to exist. This symptom is not uncommonly of great assistance in recognising the presence and situation of obscure limited disease in the abdomen, such as cancer, ulceration, or suppuration. It may also lead to the dis-

covery of undetected suppuration elsewhere. In the case of children who are too young to complain, but who cry or give other evidence of suffering, an unusual manifestation of pain during their examination must be carefully looked for and attended to, and its locality noted, as useful information may thus be obtained. It may be mentioned that general tenderness is in some instances a striking symptom of commencing rickets in children. In the case of superficial ulcers, in order to determine their condition for purposes of treatment, it is worth while to notice whether they exhibit tenderness, as well as its degree. Some ulcers are indolent, and scarcely at all sensitive; others are extremely irritable, and cannot bear the slightest touch.

3. These illustrations will suffice for the general diagnosis of tenderness, and it now remains but to point out some of the complaints in which this symptom is peculiarly prominent. Amongst these may first be mentioned superficial inflammatory affections, such as acute erythema or erysipelas, and also any condition ending in suppuration. Peritonitis is usually attended with remarkable tenderness, either generally distributed over the abdomen, or localised, according to the seat and extent of the disease. Here, however, it is necessary to guard against being misled by certain hysterical cases, in which there is intense hyperæsthesia of the skin covering the abdomen, but the distinctions already pointed out should prevent any mistake in diagnosis. Gout affecting the joints is generally accompanied by very marked tenderness, much more than in other forms of articular disease, although affections of the joints generally give rise to obvious tenderness. Hysterical patients are again liable to mislead the practitioner in this direction, as they sometimes seem to be intensely tender about a joint, when there is really nothing the matter with it. There is also a peculiar complaint met with in these subjects, called 'spinal irritation,' in which exquisite tenderness is experienced along the spine, or over some of the spinous processes (*see* SPINAL IRRITATION). Amongst other conditions which are attended by peculiar tenderness may be mentioned corns and bunions; chilblains; neuromata; superficial and multiple neuritis; certain stumps after amputation; boils; whitlows; and many affections involving such sensitive structures as the eye, or the matrix of the nails.

TREATMENT.—In the first place, of course, the disease with which tenderness is associated must be treated apart from this particular symptom, although it may afford useful indications. For example, it may reveal suppuration, when an incision will give vent to the pus, and relieve the tenderness. For the nervous and hysterical conditions in which tenderness is a prominent symptom, general treatment directed to the particular condition present is essential. When a part is really tender, all pressure must be avoided, or even, in some instances, the mere touch of such articles as clothing or bedclothes. For instance, in cases of acute inflammation of joints, or in peritonitis, it is of great service in treatment to raise the bedclothes by means of cradles or in other ways, so that they do not come into contact with the patient. All unnecessary examination of tender structures must be avoided, and such examination should be carried out very gently, if it be required. Hot and cold applications, anodynes, and allied agents may be employed locally with good effect in many conditions for the purpose of diminishing undue sensibility. *See* HYSTERIA; PAIN; and SPINAL IRRITATION.

FREDERICK T. ROBERTS.

TENDON-REFLEX. — *See* SPINAL CORD, Diseases of.

TENDONS, Diseases of. — SYNON.: Fr. *Maladies des Tendons*; Ger. *Krankheiten der Sehnen.*

Although simple in their structure, and performing a purely mechanical function of a passive kind, tendons and tendon-sheaths are liable to a considerable variety of diseases. In some instances these diseases are *primary*, and originate in the fibrous and synovial structure of the parts involved; whilst in other instances they are *secondary* to morbid conditions of the muscles, joints, and fasciæ, with which the tendons are connected. The primary injuries and diseases alone call for notice here.

1. **Injuries.**—Tendons are subject to a variety of injuries as the result of violence, such as partial or complete rupture of the tendons proper; rupture of the sheath; dislocation; incised wounds; and, most common of all, sprain of their fibres.

2. **Inflammation.**—Inflammation of a tendon and its sheath may be traumatic in origin, but it frequently makes its appearance without obvious cause, and then constitutes one form of whitlow (*see* WHITLOW). Certain effusions into the synovial sheaths may be regarded as of a chronic inflammatory nature.

3. **Rheumatic affections.**—Of greater frequency and importance are the affections of tendons and tendon-sheaths which occur in acute and chronic rheumatism, in rheumatic arthritis, and in gonorrhœal rheumatism. These will be found fully described in the several articles on these subjects. In acute rheumatism, and in the early stage of gonorrhœal rheumatism, the involvement of the tendon-sheaths may give rise to nothing more serious than pain and stiffness; but in protracted cases of the gonorrhœal affection, and in rheumatic arthritis, permanent changes may result, including contractions, adhesions, calcification, and even complete destruction.

4. **Gout.**—The tendons and their synovial sheaths are by no means an uncommon seat of gouty deposit. This condition is probably best marked in the extensor tendons of the hand, giving rise to a characteristic form of rigidity, or false ankylosis of the finger-joints.

5. **Ganglion.**—Simple ganglion is usually a local dilatation of a tendon-sheath, or a cystic formation in connexion with it. In the experience of the writer it is especially common in rheumatic subjects. *See* GANGLION.

6. **Deformities.**—The most obvious and the most common deformities involving tendons are of the nature of contractions, such as give rise to club-foot and distortions of the fingers. As a rule, these are the result of some of the morbid conditions already referred to, but in other instances they are of more obscure origin. Thus, in the so-called 'Dupuytren's contraction of the palmar fascia,' a highly characteristic deformity of the fingers and palm of the hand results from a kind of stricture of the sheaths of the flexor tendons of the fingers and wrist, due to shortening of the fibres connecting them with the palmar fascia. In several cases of this nature the writer has found marked thickenings of the extensor tendons also, where they are in relation with the interphalangeal joints.

7. **New-growths.**—Various new-growths of a fibrous, cartilaginous, osseous, or malignant nature have been found in connexion with tendons.

SYMPTOMS.—The symptoms of diseases and injuries of tendons are chiefly of an objective and easily recognisable kind. The most obvious of these is impairment of movement of the tendon in its sheath, and of the associated muscles and joints. In its slightest degree, such impairment amounts only to stiffness; but when it is more marked it may take the form of rigidity, or even complete loss of function. Deformities may then very readily arise in connexion with the joints, such as unnatural flexion or extension, or actual dislocation; whether referable to shortening of the tendon, to constriction of its sheath, to prolonged disuse of the joint, or to wasting of the associated muscles with over-action of their opponent groups. Similar results may follow rupture, wounds, or destructive ulceration of tendons.

Traumatic, rheumatic, and gouty effusions into tendon-sheaths give rise to swellings along their course, which are easily recognised if the anatomical relations of the parts be remembered, but which are probably often mistaken for intra-articular disease. Localised swellings on tendons, such as ganglia, nodules, and new-growths, present unmistakable characters.

The chief subjective symptoms connected with the diseases of tendons are pain and a feeling of stiffness. Both these symptoms vary greatly in different instances, and neither is perhaps characteristic of affections of these structures, apart from the associated muscles, bones, and ligaments.

TREATMENT.—The treatment of diseases of tendons, where it is not of a strictly surgical nature, is fully described in the several articles in this work to which reference has been made.

J. MITCHELL BRUCE.

TENESMUS (τείνω, I stretch).—SYNON.: Fr. *Ténesme*; Ger. *Stuhlzwang*.—Tenesmus is a comprehensive term applied to certain morbid sensations referred to the anus and its vicinity. There is a feeling of fulness and weight, with frequent or constant inclination to go to stool, and straining during the act of defæcation, little or nothing being passed, and that often of the nature of slimy mucus or blood, while no sense of relief is experienced afterwards. Tenesmus is a common symptom in cases of dysentery. It may also be associated with local diseases about the lower part of the rectum or anus, such as piles, fistula, or malignant disease. Other morbid sensations are often present at the same time.

TREATMENT.—Any local cause of tenesmus must be removed or cured, if practicable. The sensations are best relieved by local applications of heat or cold, wet pads, or the use of small enemata containing laudanum, or of suppositories of morphine, extract of belladonna, or hydrochlorate of cocaine.

FREDERICK T. ROBERTS.

TEPLITZ-SCHOENAU, in Bohemia. — Simple thermal waters. *See* MINERAL WATERS.

TERMINATIONS OF DISEASE.—*See* DISEASE, Terminations of.

TERMINI IMERESI, in Sicily (*Thermæ Himerenses* of the Romans).—Thermal waters. *See* MINERAL WATERS.

TERTIAN (*tertius*, the third).—A term applied to a form of intermittent fever in which the paroxysms return on the third day, or at an interval of about forty-eight hours. *See* INTERMITTENT FEVER.

TERTIARY (*tertius*, the third).—This word is usually associated with the advanced forms of syphilitic disease. *See* SYPHILIS.

TESTES, Diseases of.—SYNON.: Fr. *Maladies des Testicules*; Ger. *Krankheiten der Hoden*.—The diseases of the testes will be discussed in the following order: (1) Abnormalities of Development; (2) Hypertrophy; (3) Atrophy; (4) Injuries; (5) Acute Inflammation; (6) Chronic Inflammation; (7) Hernia Testis; (8) Cystic Disease; (9) Fibroma; (10) Chondroma; (11) Malignant Disease; (12) Teratoma; and (13) Neuralgia.

1. **Abnormalities of Development.**—(*a*) *Absence.*—There may be complete absence of the testicles. The subjects of this

imperfection, if they attain the age of puberty, present the ordinary characteristics of eunuchs. As the complete gland is formed from two distinct parts, the failure or arrest of development may be limited to either part, separately from the other. Thus cases are described where a well-developed vesicula seminalis and vas deferens have been found, without any trace of a testicle; and others, where a testicle existed with complete or partial absence of the vas deferens.

(*b*) *Excess.*—Supernumerary testicles have been described, and men not infrequently believe themselves to be so gifted. The mistake has arisen from the presence of encysted hydroceles, or of fatty or fibrous tumours of the cord, or of an old epiplocele. There is no well-authenticated case recorded of the presence of more than two testicles.

(*c*) *Malposition.*—The testicles, which are developed in the abdomen, immediately below the kidneys, are at birth, or shortly after, lodged in the scrotum. This change of position is frequently described as 'descent of the testicle,' an obvious misuse of words, if regard be paid to the usual position of the fœtus in the uterus.

The testicle may be retained in the *abdomen*, or in the *inguinal canal*; or may pass through the inguinal canal into the *perinæum*, and be lodged between the bulb of the urethra and the anterior part of the tuber ischii; or over the external pillar of the ring into the subcutaneous tissue of the *upper part of the thigh*; or through the crural canal to the *upper and inner part of the thigh*; or, if it has passed into the scrotum, may be *rotated*, so that the epididymis is in front and the testicle behind. More rarely it has the long axis transverse instead of oblique; or it may be completely inverted, so that the globus major is below, the globus minor above.

Retention in the abdomen or inguinal canal may be the result of adhesions from intra-uterine inflammation, or of disproportion between the gland and the orifices through which it has to pass, or of some constricting band. The passing through the crural canal to the thigh, or through the inguinal canal to the perinæum or thigh, must be the result of some unusual attachment of the lower end of the gubernaculum. Malposition in the scrotum must be caused by some abnormality in the development of the cord.

The consequences will vary with the position. If the testicle is retained in the *abdomen*, the corresponding half of the scrotum remains undeveloped, and the gland is always much smaller than normal. Sometimes there is an arrest of development, or it undergoes fatty or fibrous degeneration, or, if otherwise normal, does not secrete a fertilising fluid. This seems fairly established by numerous observations, both in men and the lower animals, where the testicle has been abnormally retained in the abdomen. One case, however, has been recorded by Hutchinson, where the observer, to whom the retained testicle was submitted for microscopic examination, stated that he found numerous spermatozoa.

When the testicle lies at the internal inguinal ring, the epididymis is frequently found partly in the badly developed scrotum, into which also extends the processus vaginalis. As the communication between this and the peritoneal cavity is usually maintained under such conditions, in case of peritonitis with peritoneal effusion there may be distension of this process, so as to greatly simulate a hernia, and render an exploratory examination necessary.

Retention of the testicle in the *inguinal canal* is more liable to complications than retention in the abdomen. It is often accompanied by inguinal hernia; is more exposed to injury; and when enlarged at puberty, or by inflammation, may cause severe pain from constriction by the surrounding parts.

Inflammation of a testicle retained in the inguinal canal has been mistaken for strangulated bubonocele, or for a bubo. Careful examination of the scrotum should, therefore, be made in doubtful cases.

Retraction can usually be distinguished from retention of the testicle by the state of development of the corresponding half of the scrotum.

The *perinæal* or *femoral* position of the gland is not of necessity attended with any bad results. A testicle, however, so situated, is usually smaller than normal and is more exposed to injury. This is especially the case in the perinæal position.

TREATMENT.—If retention of the gland in the inguinal canal be attended with any inconvenience, operative interference may succeed in placing it in the scrotum. But if this should fail from shortness of the cord, extirpation would be necessary. When in infants retention of the testicle is complicated by an inguinal hernia, the use of a truss is not to be recommended, as it will prevent the possible descent of the testicle, and the hernia not infrequently spontaneously subsides. If the retention of the gland be permanent and cause inconvenience, it is better to remove it at once. If the gland have passed through the crural canal, nothing can be done to remedy the malposition; but when it has passed through the inguinal canal into the perinæum or the thigh, an attempt may be made to place it in the normal position. In an adult, such a proceeding would be hopeless, from the non-development of the scrotum. In infants, the attempt has been twice made at the London Hospital, by Curling and James Adams. Both cases died; and in the one in which alone a *post-mortem* examination was allowed, acute peritonitis was found, which had extended from the pervious processus vaginalis. With antiseptic precautions, however, better results might be anticipated.

The late Mr. John Wood successfully transplanted in an infant a testicle from the perinæum to the scrotum subcutaneously. When a band of tissue in the perinæum, probably the gubernaculum, had been divided with a tenotomy knife, the gland could be pushed up to the inguinal canal, and from thence into the scrotum, where it was retained by a hairlip-pin passed above it as in acupressure. This method, when practicable, would be unattended with danger. But as sometimes the unaided efforts of nature draw the gland from the perinæum up to the inguinal ring, where it is comparatively safe from injury, and more favourably situated for any attempt at removal to the scrotum, it is advisable always in infants to allow time for such a possible modification, which might moreover be encouraged by electric stimulation of the cord.

Of malpositions in the scrotum, that where the epididymis is in front, and the testicle proper behind, is alone of any practical importance. In any operation for hydrocele or hæmatocele of the tunica vaginalis, the position of the testicle ought first to be ascertained.

(*d*) *Arrest of development.*—This sometimes occurs after the testicles have passed into the scrotum, so that these glands remain permanently in their infantile condition. No general cause has been discovered for this abnormality.

2. **Hypertrophy.**—When only one testicle has been retained in the abdomen, the other sometimes attains an unusually large size. Such cases of, as it were, compensating development are, however, the exception and not the rule.

3. **Atrophy.**—Wasting of the testicle may result from inflammation, from lesions of the spinal cord caused by injury or disease, or subsequently to injuries of the head. It may also be produced by early and excessive venereal excitement; or by deficient blood-supply, due to aneurysm or other causes. It is frequently found associated with varicocele.

4. **Injuries.**—The testes are greatly protected from accidental violence by their mobility, and the laxity of the surrounding structures. Immediate death has resulted from severe contusions of the testicle, probably from reflex inhibition of the action of the heart. Contusion and wounds require appropriate surgical treatment.

5. **Acute Inflammation.**—When acute inflammation attacks the body of the gland solely or chiefly, it is called *orchitis*; when the epididymis, *epididymitis*. For the comparatively rare cases in which the vas deferens, or this duct along with the other structures of the spermatic cord, is affected, without the testicle being implicated, the barbarous hybrids, *deferenitis* and *funiculitis* have been coined.

Ætiology.—Acute inflammation may be caused by direct violence, or by the extension of inflammatory processes from the mucous membrane of the urethra. It may also occur, though rarely, as a sequela in small-pox or in pyæmia. Orchitis is not infrequently a concomitant of parotitis or mumps.

Of these varieties, the most frequent is gonorrhœal epididymitis. This was at one time regarded as an instance of 'sympathetic inflammation.' Careful examination will, however, always prove that the vas deferens is also affected, though sometimes in so slight a degree that its participation in the inflammation might easily escape notice. This form is, therefore, due to direct extension of the inflammation from the urethral mucous membrane. Orchitis associated with mumps has been generally regarded as an instance of 'sympathy,' or 'metastasis.' Kocher, however, considers it to be the result of urethritis. According to this experienced observer, the disease commences as stomatitis, by which the parotid, or sometimes the submaxillary and neighbouring lymphatic glands become infected. The morbid material is carried by the blood to the kidneys, and in its course through the urinary passages sets up cystitis or urethritis, and thus the orchitis results. This explanation is not satisfactory, since in some epidemics of mumps orchitis has occurred prior to, or without any affection of the parotid gland. Orchitis and epididymitis sometimes occur in rheumatic or gouty subjects. Occasionally cases are met with in which no exciting cause can be discovered. It sometimes occurs in very young children, and, in the absence of any constitutional taint or other discoverable cause, probably results from some accidental injury in these cases.

Symptoms.—The symptoms of orchitis are local pain and swelling, with, in cases of orchitis sometimes, and in cases of gonorrhœal epididymitis frequently, redness and tension of the corresponding part of the scrotum. Severe lumbar pain is in some cases felt, especially by labouring men, who apply for relief on account of some supposed sprain or injury, being ignorant of, or attaching no importance to, the affection of the testicle. This is probably due to inflammation of the lumbar lymphatic glands, with which the lymphatics of the testicle freely communicate; but it may possibly be an example of 'referred sensation.'

Prognosis.—The prognosis is good. The inflammation usually subsides speedily, and leaves the gland in a healthy condition. Atrophy sometimes results after inflammation associated with mumps, or caused by severe contusion. Chronic induration of the epididymis may persist; but after some months it usually disappears. Stricture of the epididymis, or of the vas deferens, is very rare. Suppuration does not occur except in pyæmia, or after small-pox, or in strumous and very enfeebled persons.

Treatment.—Rest in the recumbent position, with the scrotum supported by a crutch-pad, and the application of ice locally, are in ordinary cases sufficient. Where rest is impossible, well-adjusted strapping of the part affords considerable relief, and promotes absorption of the products of inflammation so rapidly as not infrequently to necessitate the re-application of the strapping within twenty-four hours. Attention to diet, and avoidance of all violent exercise, will be requisite. In more protracted cases mercury, taken in small doses internally, or applied locally by inunction or on strapping, will be found of benefit. The practice, of late years recommended by some eminent surgeons, of puncture or incision of the ordinarily inflamed gland, is, according to the writer's experience, never necessary. If suppuration, however, occur, a free incision should be made as early as possible.

6. **Chronic Inflammation.**—Chronic orchitis may sometimes be the result of an acute attack, but is much more frequently induced by *syphilis*, *struma*, or *gout*.

(*a*) *Syphilitic orchitis.*—This variety may occur in young children who are the subjects of inherited syphilis, in the form of hard nodules in the testicle. In adults it belongs to the tertiary stage of the disease, but is very often symmetrical. It is usually painless, the patient being frequently ignorant of its existence. The gland is enlarged, very hard, insensitive to pressure, and often nodular in form.

Syphilitic orchitis sometimes commences in an acute form. The testicle is large, very tender on pressure, with dull aching pain limited to the gland or radiating to the groin and back. There is usually effusion in the tunica vaginalis, varying in quantity in different cases, and the scrotum is congested and œdematous. Generally only one testicle is affected, but after some weeks the other gland may also present similar symptoms. The condition resembles gonorrhœal epididymitis, but may be distinguished from it by the absence of any existing or precedent urethral discharge, by the body of the gland being solely or chiefly affected, and by the existence of concomitant syphilitic symptoms. It rapidly improves under mercurial treatment, but if left untreated generally passes into the ordinary chronic form.

Treatment.—This form of orchitis is usually very amenable to treatment, but has a tendency to recur. Iodide of potassium combined with mercury in small doses internally, when it can be tolerated, and strapping locally, will in most cases produce rapid disappearance of the disease, for a time at any rate. Atrophy may sometimes result; and in some cases suppuration, with the formation of troublesome sinuses, may occur. In one case under the notice of the writer, which was complicated by an inguinal hernia, the gland had, after very prolonged and unsuccessful treatment, to be removed, as the use of a truss caused great pain, and the non-use of it led to a dangerous descent of the hernia.

(*b*) *Strumous orchitis.*—In most systematic works on surgery tubercular disease of the testicle is given as a distinct affection, but the descriptions of it are very confused, no two being in perfect agreement. This is partly because at one time the presence of caseous matter was regarded as evidence of tubercle, and partly because in many cases microscopic examination of the gland after its removal can alone determine the nature of the disease. Tizzoni and Gaule have, therefore, proposed to substitute the term 'phthisis' for 'tuberculosis' of the testis, since in this organ, as in the lungs, tubercular and non-tubercular processes, either separately or concurrently, run the same course.

Symptoms.—Tubercular disease of the testis is not rare in young children, and usually commences in the body of the gland. It occurs, however, much more frequently after puberty, and then commences, in the majority of cases, in the epididymis; the body of the gland and the vas deferens becoming subsequently infected in the progress of the disease.

A nodular swelling is found either in the gland or in the epididymis, which is usually only slightly, if at all, painful, and runs an indolent course. After a longer or shorter time, this softens down into an unhealthy pus; adhesion and perforation of the superjacent structures ensue; and a fistula is formed. This condition may continue for a long time, but usually the disease extends to the rest of the glandular apparatus. Sometimes the testicle is very much enlarged. The vas deferens, if affected, may either be uniformly thickened, up to the inguinal ring; or present a number of distinct round or spindle-shaped enlargements. The prostatic portion of the duct, the vesicula seminalis, bladder and kidneys may be similarly affected. Digital examination, through the rectum, ought therefore always to be made.

Treatment.—The treatment of strumous orchitis consists in careful attention to diet and hygienic conditions; in the use of cod-liver oil and iodide of iron; and in the protection of the part from accidental injury by a suspensory bandage. Abscesses should be opened as early as possible, and any fistula either laid open by incision or dilated by laminaria, and treated with stimulating lotions, such as nitrate of silver of the strength of five grains to the ounce. In favourable cases the disease may be arrested, but in many cases removal of the gland becomes necessary. If the epididymis and the vas deferens are much involved, the gland, by obliteration of its duct, is functionally useless; and as there is always considerable risk of infection of the system generally, early removal of the gland is, in such cases, to be recommended. If the prostate and vesicula seminalis have become affected, this would, of course, be useless.

There is another form of caseous orchitis, not of tubercular origin, in which the intertubular lymphatic spaces of the testis become filled with a new-growth of lymphoid tissue, by which the seminal tubules are ultimately compressed and destroyed. This may become transformed partly into fibrous tissue, but in the greater part usually undergoes fatty degeneration, forming caseous masses, which subsequently break down into curd-like pus. The symptoms are very similar to those of the tubercular disease, but there is not the same danger of general infection of the system.

(*c*) *Gouty orchitis.*—Chronic orchitis from gout can be diagnosed by the history of the patient, and yields readily to the ordinary treatment for gout, but is very apt to recur.

7. **Hernia Testis.**—This morbid condition was formerly known as 'benign fungus of the testis.'

Description.—It consists of a fungous protrusion from the scrotum, of a red or yellowish-red colour, and varies from the size of a pea to that of a small egg. There are two varieties, which may be distinguished as *superficial* and *deep*. The superficial form springs from the visceral layer of the tunica vaginalis, and is very comparable to the fungous granulations occasionally met with in cases of suppuration, or in wounds of the synovial sheaths of tendons. In this the tunica albuginea is intact, but probably altered in structure. In the deep form the tunica albuginea has been perforated, and the protruded mass consists largely of seminal tubules. It cannot be regarded as an evidence of any special disease of the gland, as it may occur, but by no means necessarily, after any form of orchitis in which there has been suppuration.

Treatment.—The treatment consists in well-adjusted pressure upon the protrusion; with the occasional application of caustics, such as nitrate of silver or red oxide of mercury. Freeing the margins of the opening from adhesions, and bringing the thus liberated integument over the protrusion by means of sutures, is usually very successful. When the precedent inflammation has been due to some specific cause, the appropriate constitutional treatment must also be employed.

8. **Cystic Disease.**—Cysts are frequently found in the testicle, either separately or associated with other growths.

Description.—In true cystic disease or simple cystoma, the whole or part of the body of the testicle is replaced by a closely aggregated mass of cysts, of very variable size. Some are so minute as only to be visible on microscopic examination, while others may attain to the dimensions of a pigeon's egg. When only part of the gland is so affected, healthy glandular substance is found at the periphery, enveloping the cystic growth. The cysts have no proper wall, and are lined with shallow cylindrical epithelium, which is sometimes ciliated. They are filled with either clear watery, or sometimes very viscid, fluid; or with atheromatous matter, resembling the contents of a sebaceous cyst. Very frequently nodules of cartilage are found interposed between the cysts. The disease usually occurs in adults, but one case has been recorded where the enlargement was first observed at the age of three months. The structure seems to indicate very clearly the origin of the cysts to be from retention within the rete testis.

There is another form of cystic disease, where the cysts are separated by a considerable quantity of gelatinous connective tissue, and often contain polypoid ingrowths, which sometimes completely fill their cavities. The tumour is often as large as a child's head. This form is regarded as cystic adenoma of the gland.

Cysts of the epididymis are described in the article on Hydrocele.

Symptoms.—Cystic disease of the testicle is usually attended with very little pain. The tumour is of an oval form, either with a smooth surface, or with irregular elevations; and does not attain a very considerable size, being generally about as large as a goose's egg. There is an indistinct sense of fluctuation, unequal at different parts.

Diagnosis.—Cystic disease of the testis has sometimes been mistaken for hydrocele or hæmatocele. The form of the tumour, its relatively greater weight, the absence of transparency, and the impossibility of detecting the body of the testicle at any part, distinguish it from hydrocele. The distinction from hæmatocele is in some cases more difficult. If exploratory puncture be considered requisite, a full-sized instrument should be used, as the fluid may be so viscid as not to flow through a small cannula.

Treatment.—Castration is the only remedy for this condition.

9. **Fibroma.**—Fibrous tissue is found in abnormal quantity in atrophy of the testis, in chronic orchitis, and associated with new-growths. By fibroma of the testicle, however, is meant a new-formation of fibrous tissue to a considerable extent, without any other important change. In structure it resembles fibrous tumours of the uterus. It so rarely occurs, however, as to practically be devoid of clinical importance.

10. **Chondroma.**—Cartilage, usually of the hyaline, but sometimes of the fibrous variety, is found in association with many

new-growths in the testicle. Pure chondroma is comparatively rare.

Description.—This form of tumour of the testis occurs as disseminated nodules, connected by fibrous tissue; or as elongated masses with branching processes. By compression of the seminal tubules, it leads to dilatation of other parts of the tubules; and by invagination of the walls of such dilatations the growth often seems to be in the interior of a tubule. Careful examination, however, will always prove it to be of extratubular origin. It similarly invades the lymphatics, and through them has a great tendency to infect other parts of the system. It is often associated with myxoma; and sometimes, though rarely, it develops into bone. It can only be diagnosed with any certainty when the tumour has attained a large size, and is then characterised by the hardness and slow growth of the mass.

Treatment.—Castration is the only treatment; and in consequence of the tendency of this disease to invade other organs, the rule laid down by the late Mr. Curling is the best—'to recommend an operation without unnecessary delay, in all cases of large sarcocele which do not give any indication of yielding to treatment.'

11. Carcinoma and Sarcoma.—These are classed together, because, though histologically of very different origin, the distinction between them in any individual case is often impossible, except by microscopic examination of the tumour after removal. Even then the distinction is sometimes impossible, if we may judge from the description of recorded cases of mixed sarcoma and carcinoma.

Carcinoma originates in the epithelial structures of the gland, and is almost invariably of the encephaloid variety. Scirrhus is said by all writers to occur sometimes, and so-called specimens are in many museums. According to Mr. Butlin, however, many of these are probably examples of fibrous sarcoma. Encephaloid cancer usually commences in the body of the testis, by the formation of one or more nodules. Sometimes the epididymis is first attacked. Very rarely is there general infiltration of the gland. In an early stage of the disease the testis is hard, from tension of the tunica albuginea, but when this has been destroyed in the progress of the growth, the mass is soft, and there is often distinct fluctuation. This may be unequal at different parts, from the presence of cysts. The growth is usually painless, but in some cases there is acute pain, either locally or in the lumbar region. The chief aids to diagnosis at this period are the rapidity of the growth, the enlargement of the blood-vessels of the cord, and the age of the patient. For while encephaloid cancer has been met with in young children and old people, still the vast majority of recorded cases have occurred between twenty and forty years of age.

If the tumour attain a very large size, the scrotum may slough, and a bleeding fungus protrude. The disease has a great tendency to invade other parts of the system, and especially at an early period the lumbar lymphatic glands. This may lead to œdema of the lower extremities, from pressure on the abdominal veins. The inguinal glands generally escape infection, except in some cases where the scrotum has been involved in the disease. Secondary growths have been found in the mesenteric glands, liver, spleen, and lungs.

Sarcoma originates in the connective tissue of the testicle, and sometimes develops in both glands simultaneously. With microscopic examination two varieties can be distinguished, the round- and the spindle-celled. The latter grows more slowly, and both are often associated with cystic and cartilaginous formations. The symptoms are very similar to those of cancer.

Sarcoma sometimes commences in the tunica vaginalis, and is then usually accompanied with extravasation of blood into the sac. The writer has met with two such cases, where the shape of the tumour, the complete absence of pain, the history of gradual enlargement, and the very distinct fluctuation were suggestive of hæmatocele. Exploratory examination, however, proved them to be cases of sarcoma. Castration was performed, and the testicles were found to be only slightly affected by the disease. Both cases died within a short period after the operations, from secondary affection of other organs, accompanied by similar hæmorrhages.

Melanoma of the testis was formerly regarded as a form of cancer, but is now considered to be sarcomatous. It is extremely rare, and in the few recorded cases of it similar growths were found in many other organs of the body.

Diagnosis.—As a general rule it may be stated that sarcoma occurs most frequently under ten and after forty years of age; and that the epididymis is more frequently the primary seat of the disease, and, when secondarily involved, is attacked at an earlier period than in cancer. The distinction in any individual case must, however, be very uncertain, and is of little importance.

Prognosis and Treatment.—The prognosis is very unfavourable in both, as recurrence of the growth in other organs after the removal of the tumour is the rule to which there are but few exceptions. Castration is the only possible treatment for both diseases.

12. Teratoma.—The testis, like the ovary, may be the seat of cysts containing hair, skin, bones, &c. The cysts are sometimes within, sometimes upon the gland. The more complex cases may be best explained as resulting from the inclusion of a second fertilised germ; while the simpler cases may be due possibly to the accidental grafting of the germs of such tissues on the rudimentary testicle. The history of a congenital tumour will suffice to direct attention to any such case. They are very rarely met with, and castration is the only suitable treatment.

13. **Neuralgia and Irritability.**—The testicle is sometimes the seat of very acute persistent or periodically recurring neuralgia. This must be distinguished from hyperæsthesia or irritability of the gland, which is occasionally associated with varicocele, or may be the result of self-abuse, excessive venery, or even of unsatisfied sexual excitement. Neuralgia may be due to some local cause, to varicocele, to a descending hernia, or to induration of some part of the glandular apparatus from precedent inflammation. It may also be sympathetic, as in renal colic, or where the digestive system is disordered. Occasionally no cause can be discovered, and we have to assume that it is due to some affection of the central nervous system.

Treatment.—When of local origin, the treatment of neuralgia of the testis must be directed to the removal of the cause; and if all other methods fail, and the pain be severe enough to warrant it, castration may be required. When due to affections of other parts of the body, the treatment must be regulated accordingly.

Hyperæsthesia of the gland usually yields in time to tonics, and attention to ordinary hygienic conditions.

Jeremiah McCarthy.

TETANUS.—Synon.: Lock-jaw; Fr. *Tétanos*; Ger. *Starrkrampf.*

Definition.—A disease of the nervous system, with persistent tonic spasms and violent brief exacerbations. The spasms as a rule commence in the muscles of the face and neck, causing closure of the jaws (trismus, lock-jaw), and involve the muscles of the trunk more often than the limbs. The onset is acute, usually due to a wound (traumatic tetanus), at times without an external injury, specially from exposure to cold (idiopathic or rheumatic tetanus). It occurs also in newly born children (tetanus neonatorum), and rarely after childbirth, or abortion (puerperal tetanus).

Ætiology and Pathology.—Tetanus is believed to depend upon a poison, produced in the bodies of persons infected with a specific bacillus which exists in different forms of mould. If earth mixed with this tetanus bacillus is inserted beneath the skin of the lower animals, symptoms of tetanus are produced. Tetanus has also been transmitted from man to the lower animals by the inoculation of materials from wounds, and the injection of blood and of urine containing this bacillus. The bacillus multiplies principally in and about the wound: having probably been introduced into the injured tissues with dirt, it there produces a poison which we suppose causes the symptoms of tetanus. Our knowledge regarding the pathological changes produced by this poison is still vague, neither the nervous centres nor any other part of the body presenting characteristic lesions after death from this disease; but the symptoms which characterise it are referable to an abnormal influence acting on nerve centres which control the voluntary muscles affected. Professor Clifford Allbutt, and other observers, have described the pathological changes in the spinal cord after death from tetanus as consisting of intense congestion of the tissues, with structureless exudations, especially in the grey matter. It is difficult to determine, however, whether these changes are the causes, or simply the effects of the abnormal nerve-action which characterises tetanus.

It is urged, however, that there is much in the phenomena presented by some instances of traumatic tetanus to lead us to think that the violent spasm of the muscles in this disease is due to irritation set up in the peripheral distribution of a nerve; and that this hyper-action, once established, is conveyed along the nerve to the spinal cord, exciting by reflex action the muscles near the injured nerve to a state of spasm. The irritation is supposed to extend to the whole length of the spinal cord, so that a slight impression on the skin is sufficient to produce general tetanic convulsions. In support of this theory a few cases have been recorded in which division of the principal nerve, or in other instances the stretching of a nerve leading from a wound, has completely stopped an attack of tetanus. And in some cases the writer has certainly seen tetanic spasms commence as if by reflex action. For instance, after ligature of a large bleeding pile, the patient, within thirty-six hours of the operation complained of spasms of the sphincter ani muscle; and although the ligature was instantly removed, the disease ran a rapid and fatal course.

On the other hand, the circumstances of tetanus, when considered in all their bearings, point to some influence at work which is different in its nature from that of ordinary reflex action. It is the exception rather than the rule for the muscles in the neighbourhood of the wounded part to be first involved in the disease, as they probably would be if it arose from a purely reflex action; it matters not where the seat of the injury may be, in by far the greater number of cases the muscles of the face are affected before those of any other part of the body. In most instances of tetanus, for twenty-four or forty-eight hours before spasms of the muscles have set in, the patient's face presents a pinched appearance, which is characteristic of the disease, and depends on rigidity of the muscles of expression. Various groups of muscles are subsequently involved, in the following order—those of mastication, the neck and back, the muscles of respiration, and, lastly, those of the extremities. So generally is this the order in which the muscles are implicated, that it appears as if the poison causing the disease affects, first, the medulla oblongata, and afterwards extends to the spinal cord.

We must, however, admit, that cases of tetanus are met with among patients in whom it is impossible to discover any wound or abrasion of the skin of the body,[1] or mucous membranes, and in instances of this description, it is difficult to understand how the disease can depend either on reflex action or from a poison produced by a bacillus.

It seems certain that local conditions and meteorological changes greatly influence the development of tetanus. In the tropics, the disease is far more frequently met with than in other parts of the world. It is seldom absent from the Calcutta Hospitals, and in some seasons appears to prevail as an epidemic. It is, in fact, a matter of common observation in Bengal, that after sudden changes of temperature cases of tetanus appear among surgical patients; so that, while admitting that in many instances of tetanus, wounds or injuries are the first step in the disease, we cannot overlook the fact that a chill is frequently its immediate antecedent. The disease attacks persons of all ages; it occurs occasionally among infants immediately after birth, but more commonly commences a few days after the remains of the umbilical cord have separated from the child's body. Men are more subject to tetanus than women. In the tropics tetanus is by no means uncommonly met with among horses, especially after they have undergone the operation of castration.

Symptoms.—In cases of traumatic tetanus the symptoms usually commence from the fifth to the fourteenth day after the infliction of the wound. The symptoms begin in man, or in the lower animals, whether of traumatic origin or otherwise, in rigidity of the muscles of expression. In the course of a few hours the muscles of mastication, and of the head, neck, and back become involved, so that the patient experiences difficulty in opening his mouth, or in moving his head from side to side; deglutition is impeded by spasmodic contraction of the muscles of the pharynx. The rigidity of one or more of the groups of muscles above referred to, is constant throughout the whole course of the disease; but in addition to this, from time to time these muscles are thrown into the most frightful spasms; in this way the patient's body is sometimes bent like a bow, the whole weight of the trunk being supported on the back of his head and heels. The abdominal and thoracic muscles are also implicated, and hence the patient's belly is tense and hard, and the walls of his chest expand imperfectly in breathing. The muscles of the arms and legs are often extremely rigid, and convulsed in a violent manner; they are the seat of terrible pain. The interval between the paroxysms of spasm of the affected muscles is uncertain; sometimes the cramps last only for a few seconds, at other times for five, and even ten minutes. The most dangerous cases of tetanus are evidently those in which the muscles of respiration are principally involved, for death is generally caused in this disease by the interference with the respiratory process, the chest being, as it were, compressed in a vice (Watson). In consequence of the spasm of the muscles of the neck and thorax, the sick person is unable to speak, but his intellect generally remains clear up to the last, nor are the other functions of his body materially deranged. The patient suffers much from hunger and thirst, which he is unable to alleviate; and, above all, he longs for sleep, which is frequently denied him in consequence of the recurring spasms. The surface of the skin is bedewed with perspiration; and the pulse rises and falls with the intensity of the spasms, and the duration of the disease. The temperature will be described presently.

Puerperal tetanus is most frequently met with in tropical countries; of fifty cases which occurred in a temperate climate, eighteen came on after abortion, from the second to the fourth month of pregnancy. In most cases the disease has made its appearance after plugging the vagina; in cases of adhesion of the placenta; or after operations have been performed for the delivery of a fœtus. The symptoms are the same as those above described. This form of the disease is very fatal.

Tetanus neonatorum generally commences from the second to the third week of life; seldom later. It is rarely met with in this country, except in St. Kilda. Occasionally it is seen in tropical countries.

Course and Duration.—Tetanus is one of those maladies which run a definite course, although its duration is not so precisely defined as that of some other diseases. It may kill the person affected in the course of a few hours; but in the greater number of instances patients die of tetanus from the seventh to the eleventh day after the commencement of the disease. If the patient survive the twelfth day, the malady generally subsides. He may usually be pronounced cured in twenty-five days from the commencement of the attack; but the patient often suffers for many weeks subsequently from rigidity of the muscles which have been involved in the tetanic spasms.

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[1] In the surgical wards of the Mayo Hospital, Calcutta, within a period of five years, 83 cases of tetanus were treated. Of these, 44 cases were traumatic, and 24 died. Of the remaining 39 idiopathic cases, 10 died.

Prognosis.—Tetanus is a very fatal disease. The writer has relied much on the thermometer, not only as a means of forming a prognosis, but as indicating to some extent the treatment to be followed in tetanus. Doubtless in some of the worst instances of this disease the thermometer fails us; for if the muscles of respiration are much affected, as they are in the most severe cases, the process of combustion within the body is so much interfered with, that its temperature is not kept up to the degree we might expect, in proportion to the violence of the muscular action. Nevertheless, as a general rule, in instances of tetanus, so long as the thermometer indicates that the temperature of the patient's body is under 101° F., it is probable the patient will recover. If it rises beyond 101°, there is impending danger; and if it reaches 103°, the case is one to cause the greatest anxiety. After death from this disease the temperature of the body not infrequently rises as high as 107°.

Treatment.—One of the most remarkable facts connected with tetanus, is the almost incredible amount of Indian hemp and opium which persons suffering from it may be given, without these drugs producing their poisonous effects on the system. The writer has prescribed them in large doses, but has failed to satisfy himself that they influence for good the progress of the malady. He has also given the Calabar bean a fair trial in tetanus; but unless it be pushed to the extent of rendering the patient collapsed, the temperature of his body falling perhaps to 94° or 95°, and the pulse being hardly perceptible at the wrist, he has found that this medicine hardly affects the spasms of tetanus in severe cases, whilst in the milder forms of the disease there is no necessity for resorting to such a dangerous means of relief. In fact, we know of no treatment which will cut short the progress of a case of tetanus; we must therefore employ our efforts to keep the sick person alive during the illness through which he is passing. As a means to this end, we must feed him, and, if possible, secure him at least some six hours' sleep during the day. With respect to food, the patient must be ordered about four ounces of milk every four hours; one egg, or half an ounce of the juice of raw meat, being mixed with his milk, morning, noon, and evening. If the pulse indicates great exhaustion, beef-tea and brandy may be given as an enema, in addition to the above-mentioned food. In cases of tetanus the teeth are often so firmly locked together that it is necessary to insert one's fingers between the closed jaws and the cheeks, and pour the milk into the cavity thus formed; the liquid will trickle between and behind the patient's teeth, and pass down his throat. Some of it may occasionally run into the trachea, and cause considerable spasm, but no serious result follows from this. In these cases food may be administered not only by the rectum, but also by a nasal tube. If the patient can swallow with comparative ease, arrowroot may be mixed with the milk.

With reference to drugs, no medicine probably procures sleep so well as the hydrate of chloral in cases of tetanus. It should be administered in 40-grain doses (to an adult) at bedtime; and in severe cases of the disease (the temperature of the patient's body rising to upwards of 101°) an additional 30 grains of chloral should be given at midday. However serious the case may seem to be, we should rigidly adhere to this plan of treatment, the urgency of the symptoms not causing us to deviate from our attempts to administer to the patient a sufficiency of food, and enough hydrate of chloral to make him sleep some six hours in the twenty-four. It is much better to give a full dose of chloral once, or even twice, a day than to administer small doses more frequently.

N. C. Macnamara.

TETANY.—Synon.: *Tetanilla*; Idiopathic Muscular Spasm; Fr. *Tétanos Intermittent*; Ger. *Tetanie.*

Tetany is a neurosis described originally by Dance in 1831, and more or less fully since under many names, especially in France. It is probably much more common in that country than in England, where it is very rarely met with. It is mostly a comparatively trivial and temporary malady.

Ætiology.—Tetany is associated with no recognised organic changes in any part of the nervous system; and much uncertainty prevails in regard to its causation. It occurs mostly between the ages of fifteen and thirty years, though it may show itself in older people, as well as in young children and even in infants. It occurs in either sex, but is more common among females. Persons of a neurotic temperament, or those whose constitutions have been disturbed or weakened from many causes, are specially liable. Teething, the establishment of menstruation, chronic diarrhœa, lactation, the state of convalescence from many acute diseases, are all conditions which predispose to this affection; whilst exposure to cold and emotional disturbance seem to act as the most common exciting causes.

Symptoms.—The morbid manifestations of tetany consist, in the main, of tonic spasms, frequently recurring for brief periods in one or other part of the body, painful in character, and unaccompanied by loss of consciousness. The attacks in different individuals vary widely, the spasms being sometimes quite local, sometimes involving many different regions of the body.

In the *slighter kinds* of attack, a numbness and tingling is felt in the fingers and toes, which speedily become fixed in tonic spasm. As the spasms strengthen, they may extend to higher parts of the limb and become painful. The fingers are drawn together and slightly flexed, the thumb is bent into the palm, and the wrist slightly flexed. The toes also are drawn together and towards the sole, the big toe being drawn under them. The dorsum of the foot is arched, and the heel pulled up, whilst the leg and thigh are more or less rigidly extended. One or more of the limbs may be affected in this way; or if all are implicated, it may be simultaneously or successively. This condition of things lasts for a few minutes, or even for an hour or two, accompanied often by severe pain along the nerve-trunks, and by some diminution of sensibility in the parts affected. When the attack is about to terminate formication sets in, as at the commencement of the spasm. After variable intervals the attacks are renewed, it may be in an hour or two, or only after several days. Such paroxysms may be frequent during several months; and, according to Trousseau, so long as a tendency to recurrence of the spasms exists, they may always be excited anew by simply 'compressing the affected parts, either in the direction of their principal nerve-trunks, or over their blood-vessels, so as to impede the venous or arterial circulation.' On the other hand, the application of cold to the parts affected frequently arrests the spasms for a time.

In the *more severe forms* of tetany, the attacks may begin in the manner above indicated in the upper extremities, next in the lower extremities, and then, whilst diminishing in the parts first affected, the spasms may extend more or less generally to the muscles of the trunk. The contractions are invariably more or less painful. The spasms may even spread to the facial muscles, so that the jaws may be firmly clenched, and speech greatly embarrassed. If the muscles of the larynx are involved, as well as those of the chest and abdomen, extreme dyspnœa may be induced. Still there is no loss of consciousness. These attacks may be of brief duration; or they may be extreme in degree, long-continued, and frequently repeated. In these latter severe cases there is slight elevation of temperature, with greatly quickened pulse, and a furred tongue. After some weeks or months the paroxysms usually become less severe and less frequent, and finally cease altogether.

Diagnosis.—The diagnosis must be based upon the progressive character of the attacks; upon the fact that they begin in the upper and lower extremities, and after a time completely intermit; upon the absence of all loss of consciousness during the attack; and upon the fact of the possibility of reinducing the paroxysms by pressure upon the nerves or vessels of the parts affected. These characters will suffice to distinguish the affection from tetanus, epilepsy, and hysteria.

Prognosis.—The prognosis is usually favourable, the complaint gradually subsiding after a few months. Still, in very exceptional cases, the patient may die asphyxiated during one of the extremely severe attacks.

Treatment.—The treatment of tetany should in the main be directed to the improvement of the patient's general health, and the diminution of all debilitating conditions or causes of irritation. At the same time, we must endeavour to lessen the general mobility of the nervous system, by seeing that the patient obtains regular and sound sleep, as well as by the administration of one or other of the bromides in suitable doses, in combination with valerian, musk, conium, or other antispasmodic remedies.

H. Charlton Bastian.

THALAMUS OPTICUS, Lesions of.

—Synon.: Fr. *Maladies des Couches Optiques*; Ger. *Krankheiten der Sehhügel.*

Introduction. — Diseases of the optic thalamus vary in their symptomatology, according as the lesion is strictly limited to the ganglion itself, or implicates also neighbouring structures.

In the former case it is apparently well established by numerous recorded cases that lesions, such as apoplectic cysts or areas of softening, may exist without producing any discoverable symptoms, in the domain of either motility or sensibility, general or special. This is more particularly the case when the lesions occupy the convexity or ventricular aspect of the optic thalamus.

But more frequently diseases affecting the optic thalamus implicate also, directly or indirectly, the corpus striatum, internal capsule, crus cerebri, or corpora quadrigemina. Owing to the community of vascular supply between the corpus striatum and optic thalamus through the opto-striate arteries of Duret, embolism or rupture of these vessels leads to conjoint destruction, more or less extensive, of both ganglia, as well as rupture of, or pressure on the fibres of the internal capsule. A hæmorrhage or embolism in this region produces hemiplegia of the opposite side of the body. But that the hemiplegia cannot be due to the lesion of the optic thalamus is clear from the fact that such lesions may exist without any motor paralysis whatever. It is, therefore, more logical to attribute motor paralysis, when it does occur in connexion with lesions of the optic thalamus, to implication, direct or indirect, of the corpus striatum or the motor fibres of the internal capsule.

Localising Phenomena.—It is a question

whether, apart from considerations as to causation, there are any symptoms specially characteristic of hæmorrhages in the region of the optic thalamus.

Among other symptoms noted are clonic or tonic spasms of the paralysed limbs in a considerable number of the cases. Although these, according to Dr. Bastian, occur in about three-fourths of the cases, they cannot be regarded as pathognomonic, for similar spasms may occur from lesions elsewhere, as in the cortex, centrum ovale, and pons.

Nor is it true that lesions of the optic thalamus specially cause paralysis of the upper extremity, as has been contended by Saucerotte and others. The leg may suffer quite as much; and indeed, when the motor paralysis is associated with anæsthesia, the affection of the leg is frequently much more pronounced than that of the arm or face.

The occurrence of anæsthesia on the paralysed side is more constant and more enduring when the lesion invades the optic thalamus and its neighbourhood than when it is confined to the ganglia of the corpus striatum. This is owing to the fact that the posterior fibres of the internal capsule are directly injured, and not merely pressed on, as in the latter case. The anæsthesia may involve the special senses as well as common sensibility, but more frequently the tactile sensibility only is distinctly impaired. The reflex cutaneous excitability is also greatly diminished, as has been shown by Crichton Browne (*West-Riding Asylum Reports*, vol. v.). The paralysed limbs are frequently also affected with unsteadiness, tremors, or choreic-like spasms, intensified on volitional efforts. This affection, termed *post-hemiplegic chorea* (Weir-Mitchell, Charcot), is generally, if not invariably, associated with a greater or less degree of impairment of sensibility in the affected limbs. It is doubtful how much, if anything, can be assigned to the lesion of the optic thalamus itself in the causation of these symptoms. But for regional diagnostic purposes they may be regarded as significant of lesion of the optic thalamus and its immediate neighbourhood. When the lesion involves only the posterior fibres of the internal capsule, lying external to the optic thalamus, the result is hemianæsthesia, general and special, of the opposite side of the body. The power of movement may not be apparently affected. If it be, the leg is, in general, relatively more affected than the arm. But, though the motility is retained, the muscular sense is lost, so that the patient is unaware of the state of contraction of the muscles or the position of the limb, and requires the aid of vision in guiding its movements.

Cases have been recorded by Dr. Hughlings Jackson and others, which render it in the highest degree probable that lesions of the posterior aspect of the optic thalamus, and region of the corpora geniculata, cause hemiopia towards the side opposite the lesion, from paralysis of both retinæ on the corresponding side. A similar result ensues from direct lesion of the optic tract, however, and also from severance of the medullary fibres of the occipito-angular region. Hence hemiopia alone, without other symptoms, cannot be taken as absolutely diagnostic of lesion of the posterior aspect of the optic thalamus. Conjoined with affection of the other forms of sensibility, however, it points to lesion in this region.

Tumours of the optic thalamus, in addition to the general symptoms of intracranial growths (though sometimes these even seem to have been wanting), produce either no special symptoms, or such a variety as to render the regional diagnosis very uncertain or altogether impossible. The symptoms may be those indicative of lesion of the internal capsule, both its motor and sensory strands; or they may be such as have been observed in connexion with lesions of the corpora quadrigemina.

It will thus be seen that, in respect to the regional diagnosis of diseases of the optic thalamus, we are obliged to rely on a combination of symptoms, not one of which can be regarded as absolutely depending on the optic thalamus itself, and that our localisation is at best only approximate.

D. FERRIER.

THANET, Isle of, in Kent.—A dry, bright, bracing, marine climate. Principal resorts: Margate, Ramsgate, and Broadstairs. *See* CLIMATE, Treatment of Disease by.

THERAPEUTICS (θεραπεύω, I attend). SYNON.: Fr. *Thérapeutique*; Ger. *Therapie.*

DEFINITION.—The science and art of healing.

INTRODUCTION.—Therapeutics is the most essential part of medicine, for although other parts of medical science are interesting to the practitioner, it is the cure of disease at which he should aim, and it is that which the patient seeks. Therapeutics may be divided into two classes—the therapeutics of fancy, and the therapeutics of fact. In order to cure disease with certainty, the practitioner must know what the nature of the disease is, and what the action of his remedies will be. When these are positively known, therapeutics becomes a science, but when either is uncertain it is simply an art. Its principles may hereafter become a science, but its practice must always remain more or less an art, and be dependent for success upon the skill of individuals. For the symptoms which ought to indicate to the practitioner the nature of the disease may be wrongly interpreted by him, or, as it is usually termed, he may form a wrong diagnosis, and thus be led to apply wrong remedies. The idea in the practitioner's mind may correspond more or less exactly with the condition of the patient, or may not have the slightest resemblance to it; and it is only by careful comparison and experiment that their agreement can be ascertained. An absurd fancy of the practitioner will lead to absurd treatment, and the therapeutic results will not be satisfactory.

History.—In all ages of the world's history we have had the therapeutics of fancy and the therapeutics of fact running side by side, and in proportion as the latter has predominated has treatment been improved. In primitive times the imagination of physicians was busy with fancies regarding the nature, the causes, and the cure of disease. The nature of the disease was sometimes supposed to consist in the possession of the body by an evil spirit, which caused the morbid symptoms, and the cure consisted of various incantations and exorcisms. At other times the disease was supposed to consist in alterations of the fluids or of the solids of the body, or of the formative principle which pervaded them. It was supposed that in disease the juices left their proper places in the body, or became disproportioned in quantity, or that the atoms and pores of the solids became altered, so as no longer to allow of free atomic motion. At other times, again, morbid conditions were attributed to fermentation, with production of alkalis or acids in the body; and later on, when the contractile power of muscular fibre was recognised, diseases were supposed to be due to spasm or to atony. Many fanciful qualities were attributed to medicines, some being reckoned hot, some cold, some astringent, some opening and some closing the pores, some contracting and some relaxing the muscular fibres, and some being supposed to cure disease because there was some external resemblance between them and the organ of the body affected.

Principles.—The unsatisfactory results of such fanciful therapeutics have led some, in all ages of medicine, to a more or less *experimental* therapeutics. Physicians saw men suffering and dying all around them, and could not wait for exact knowledge. They therefore applied themselves to tentative therapeutics, giving first one thing and then another in the hope of doing good, and collecting the results of these experiments on their patients, for the guidance of themselves and others in subsequent cases. The results thus obtained, showing that a certain drug was useful in a certain disease without the reason of this utility being known, constituted *empirical* therapeutics. In order to obtain a broader basis than that afforded by the observation of any single man, some have collected numbers of cases from various observers, and have analysed and tabulated them. The results of this method constitute *statistical* therapeutics. But it is liable to great fallacies, inasmuch as cases which are very different are tabulated, for convenience sake, under the same name, and the results are, therefore, rendered untrustworthy.

The problem placed before the practitioner in the treatment of any one case is rendered exceedingly difficult, not only by reason of the complexity of the bodily mechanism itself, but by the manifold alterations to which it is subject in disease, and the variations produced in the action of a drug by alterations in dose, by differences in the original constitution of the patient, and further differences superinduced by the disease. So complex, indeed, is the problem, that it is impossible to unravel it by any number of observations in disease, and it can only be solved by making ourselves acquainted with a few of the conditions at a time. This can only be done by experiment upon animals, for human life is too valuable to justify the necessary sacrifice. By experimental physiology, the functions of the various parts of the body and their relations to each other are being gradually ascertained; in experimental pathology diseases are induced artificially, in order that we may discover the alterations produced by them in the functions; and in experimental pharmacology, drugs are administered in order to determine the part of the body which they affect, and the nature of the alterations which they produce in its function. The problem being thus simplified, the practitioner may hope to recognise, from the symptoms of the patient, the organ affected by disease, and the nature of the disturbance in its function, and to apply with some degree of success a remedy which will counteract such disturbance. This constitutes *rational* therapeutics. Great advances have of late years been made in this direction, but it will be a long time yet before we can hope to attain such exact knowledge as we desire, and at present our therapeutics must be to a certain extent empirical. When directed towards the removal of the cause of the disease, it has been called *pathogenetic* therapeutics. When this cannot be recognised, or cannot be removed, the treatment is directed to those parts of the organism on which the cause of disease acts, so as to lessen or remove the symptoms which it would otherwise produce. This is *symptomatic* therapeutics. And when we can neither remove the cause nor relieve the symptoms, but are forced to trust to the *vis medicatrix naturæ*, and try to maintain the patient's strength by food and nursing, we have *expectant* treatment. This might perhaps also be called expectant therapeutics, for although in its narrowest sense we understand by 'therapeutics' cure by means of medicines, in its wider acceptation the term includes nursing, domestic sanitation, climate, and other measures of treatment, such as regulated exercise, regulated gymnastics, friction, massage, and the application of heat, or of cold water.

T. Lauder Brunton.

THERMOMETER, Clinical (*θέρμη*, heat; and *μέτρον*, a measure).—Synon.: Fr. *Thermomètre*; Ger. *Thermometer.*

Definition.—An instrument for measuring different degrees of heat or cold of the human body.

Description.—The thermometer was invented by Galilei, about 1603, but it was Sanctorius (1561-1636) who first formed the idea of investigating the temperature of the human body in health and disease. The substances made use of in the construction of thermometers are mercury, first used by Fahrenheit; a coloured fluid—such as alcohol; or air. Any of these substances, enclosed in a fine exhausted glass tube, expanding at one end into a globular or cylindrical bulb, represents a thermometer. On applying heat or cold to the bulb the contents expand and rise, or contract and descend in the tube respectively. The extent of the rise or fall can be expressed in numbers on a scale, which is engraved on the stem or on a separate piece of white glass, or on a strip of paper fixed to the stem, and enclosed with it in a wider glass tube.

The thermometers used in this country and in the United States are graduated with *Fahrenheit's* scale, whereas on the Continent of Europe the *Centigrade* or *Celsius* scale is now everywhere used for medical and scientific purposes, the *Réaumur* scale falling more and more out of use. The difference between these three scales is this, that in the Centigrade and Réaumur scales the melting-point of ice is marked zero, and the boiling-point of water (or rather the heat of the steam of water boiling at an atmospheric pressure equal to 29·92 inches of mercury) marked 100° and 80° respectively; whilst Fahrenheit marked the former by 32° and the latter by 212°. Therefore 180 degrees of the Fahrenheit scale are equal to 100 degrees centigrade and 80 degrees Réaumur; and the relation of the three scales to each other is as follows:—

$$\begin{array}{ccccc} \text{F.} & & \text{C.} & & \text{R.} \\ 9 & : & 5 & : & 4 \end{array}$$

One degree of F. = $\frac{5}{9}$ C. or $\frac{4}{9}$ R.; one degree C. = $\frac{9}{5}$ F.

In converting degrees of the Fahrenheit scale into centigrade degrees, it must, however, be borne in mind that zero of the C. scale corresponds to 32 of the F. scale; 32 must therefore be deducted in converting a certain degree of the F. scale into the corresponding degree of the C. scale, and 32 must be added when C. degrees are to be expressed by the corresponding degrees of F. The formulæ for these conversions are, therefore:—

$$x \text{ deg. F.} = (x - 32) \times \tfrac{5}{9} \text{ deg. C.}$$
$$x \text{ deg. C.} = (x \times \tfrac{9}{5}) + 32 \text{ deg. F.}$$

For instance:—

$$99{\cdot}5 \text{ F.} = (99{\cdot}5 - 32) \times \tfrac{5}{9} = 67{\cdot}5 \times \tfrac{5}{9} = 37{\cdot}5 \text{ C.}$$
$$39 \text{ C.} = (39 \times \tfrac{9}{5}) + 32 = 70{\cdot}2 + 32 = 102{\cdot}2 \text{ F.}$$

It will be convenient, for quick reference, to give the corresponding degrees of the Fahrenheit and Centigrade scales in that range with which human physiology and pathology are concerned, side by side:—

F.	C.
95·0	35·0
96·0	35·55
96·8	36·0
97·0	36·11
98·0	36·66
98·6	37·0
99·0	37·22
99·5	37·5
100·0	37·77
100·4	38·0
101·0	38·33
101·3	38·5
102·0	38·88
102·2	39·0
103·0	39·44
103·1	39·5
104·0	40·0
104·9	40·5
105·0	40·55
105·8	41·0
106·0	41·11
106·7	41·5
107·0	41·66
107·6	42·0
108·0	42·22
108·5	42·5
109·0	42·77
109·4	43·0
110·0	43·33
111·2	44·0
112·1	44·5
113·0	45·0

In thermometers for clinical use the degrees on the scale ought to be divided into fifths. Thermometers ought to be carefully compared from time to time with a standard instrument, as they are liable, after a certain time, to give abnormally high indications owing to the bulb gradually contracting a little. Great improvements in the manufacture of glass for thermometers have, however, recently been introduced by Abbé and Schott (Tenaër Normalglas), whereby this drawback has been reduced to a minimum. In England thermometers may be sent for comparison with a standard instrument to the Kew Observatory; in Germany to the Imperial Physico-Technical Institute, Sect. II., at Charlottenburg, near Berlin.

Of great convenience for clinical use has been the introduction of self-registering mercurial maximum thermometers. It is not without interest to notice that a self-registering thermometer, by a small piece of iron being introduced into the tube, had been used by Currie at the end of the last century; but just as Currie and de Haën's work with the thermometer had been entirely forgotten for half a century, so were self-registering thermometers only used again in medicine some time after the ordinary thermometer had been re-introduced into clinical practice by Baerensprung, Traube, and Wunderlich. Casella was the first maker who constructed a registering clinical thermometer, by introducing a small quantity of air into the tube, and thereby separating a small part of the mercurial column from the rest. Instruments are now made in which the index—that is, the small separated part of the mercurial column—is prevented from falling back into the bulb, or in which an index is only formed each time the mercury rises out of the bulb. In using an instrument of this kind, the index, it need hardly be said, must be carefully shaken down below 95° or 90° before the thermometer is applied to the patient.

Another principle has been followed in the construction of very sensitive instruments for special researches on temperature, namely, that of the thermo-electric apparatus. The electric current that is produced in a circuit composed of two different metals when their point of contact assumes a different temperature from that of the other ends, or again, as first observed by Svanberg, the changes that a galvanic current shows when the resistance of a part of the circuit is altered by a change of temperature acting on it, can be measured by a galvanometer enclosed in the circuit. Gavarret, Heidenhain, and other physiologists have used the thermo-electric pile in physiological investigations in animals. J. S. Lombard, Hankel, Kunkel, and others, have applied it to observations in man. More recently a convenient form of thermo-electric apparatus for clinical purposes has been devised by Rédard. The apparatus, constructed on the last-mentioned principle by C. W. Siemens, for measuring deep-sea temperatures, might also easily be adapted for clinical purposes.

A self-registering apparatus for continuous observations, on the principle of an air-thermometer, has been constructed by Marey; and an instrument automatically registering the changes of temperature on the surface of the body during a certain time was devised by Mr. W. D. Bowkett (*Lancet*, July 1881). A very neat little metal thermometer in the shape of a small watch, showing the movements of a 'Bourdon tube,' which are caused by variations of temperature by the hand moving on the watch-face, has been constructed by Immisch. This can be placed in the axilla or between any folds of the skin, on the surface of the body or inside the mouth, and will correctly indicate the temperature. By a special arrangement the hand can be fixed before removing the instrument, which then acts as a maximum thermometer. But, although convenient for isolated observations and under special circumstances, it cannot for general clinical purposes compare with the ordinary glass thermometer, which, it need hardly be said, it surpasses in solidity.

For measuring surface-temperatures, mercurial thermometers of special shape, namely, a long cylindrical bulb coiled up in one plane at a right angle to the stem, have also been constructed. A thermo-electrical apparatus, or Bowkett's or Immisch's instruments, are, however, more sensitive and more convenient for that purpose.

Applications of the Thermometer.—The object we generally have in view with clinical thermometry being to examine as nearly as possible the temperature in the interior of the body, or the blood-heat, which is less variable than that of the surface (*see* TEMPERATURE), the localities most suitable for applying the thermometer would be the natural cavities, or the openings by which a thermometer might be introduced to a certain depth into the interior of the body. In the rectum, vagina, or bladder, the temperature is not subject to the ordinary changes acting from without, and the time required for taking an observation with the thermometer in any of these localities would be only such as is necessary for raising the temperature of the mercury to that of the surrounding mucous membrane. This time might be materially shortened by previously heating the thermometer to a degree a little below or above that to be expected in the body. With this preliminary measure an observation of the temperature in the rectum or vagina will not take more than half a minute.

The case is very different if we take the temperature in a cavity of the body which is not always closed, such as the mouth; or in the axilla, which can be formed into a closed cavity only by placing the arm closely against the chest. Here, quite independently of the sensitiveness of the thermometer, the time required for an observation is much longer, because the temperature of the mucous membrane of the mouth, or of the skin of the axilla, begins itself slowly to rise after the closing of these cavities, until it is raised to that of the deeper tissues which are not exposed to the loss of heat from without. Whereas nine to eleven minutes on an average are required for an observation of the temperature in the mouth, ten to twenty-four may be necessary for the mercury to become stationary in the axilla. The time varies also according to the state of the general circulation. It will be found much longer in persons with a weak circulation, for instance, in a case of heart-disease, than in the case of a vigorous patient with a good circulation and with febrile heat. It is evident that, as was first pointed out by Liebermeister, the time for an observation in the mouth or axilla can be materially shortened, not so much by previously heating the thermometer, as by, previously to the introduction of the latter, keeping the mouth or axilla closed for ten to fifteen minutes. These cavities will then have assumed a steady temperature, and the time required for the observation will only be that necessary for raising the temperature of the mercury and the glass to the temperature of the surrounding parts. It is, therefore, a good plan, if the patient had been lying on one side, to turn him over to the other, or to make him lie on one side for a time before the thermometer is introduced, and then to place the thermometer in that axilla which had been closed by the position of the patient. If the skin of the axilla be very wet with perspiration, it ought to be wiped dry before applying the thermometer.

For practical purposes the rule generally recommended in observations being taken in the axilla, to leave the thermometer until the mercury has remained stationary for five minutes—a rule which naturally applies to self-registering no less than to ordinary thermometers—secures sufficient accuracy; and this rule should be given to nurses and attendants to whom the observations are left. Especially in obscure cases, in which much depends upon the discovery of even a trifling elevation of the temperature above the normal standard, which may be of great importance for diagnosis, this precaution ought never to be omitted; and for observations requiring scientific accuracy, as, for instance, when the effect of some drug on the temperature of the body is being studied, the observations ought to be made by the physician himself.

For various reasons the axilla is the locality most suitable, and therefore generally used, for thermometrical observations. In very young or restless children, however, as well as in very emaciated adults, axillary observations would become untrustworthy. In such cases, or where patients are in an insensible state, or under special circumstances—for instance, when a great divergence exists between the axillary and the internal temperature, or when doubts arise as to the correctness of an axillary observation—the rectum, or eventually the vagina, may be used for applying the thermometer, and with a self-registering thermometer this can be done without unnecessarily uncovering the patient. In using the rectum, great care must be taken not to let a small instrument slip into it, and in restless children to prevent the instrument from being broken. This is best prevented by placing the patient on his side, and while the thermometer is kept *in situ* with one hand, letting the other one rest on the hip of the patient, in order to be able at once to arrest any turning movement which he might happen to make. The thermometer ought to be introduced about two inches deep into the rectum; and may, before being taken out, be gently pushed forward a little more, in order to bring the bulb in contact with a fresh part of the mucous membrane, which has not been cooled by the thermometer. When large masses of fæces fill the rectum, the thermometer passing into them may indicate a somewhat lower temperature than when in contact with the mucous membrane.

Other places of application, such as the inguinal fold, or the fold of skin between the thumb and the second metacarpus, may be used for special, but are quite unsuitable for general, clinical purposes. The clinical thermometer ought always to be carefully washed after being used.

Thermometrical Records.—It is extremely useful to register on a chart the thermometrical observations in a case of disease, and to connect the marks by lines; the curves which are thus formed being quite typical in many diseases. On the same chart may be entered, also by marks and lines, or otherwise, the numbers of the pulse and respirations, as well as remarks concerning other symptoms, or the treatment. For observations made with the thermometer, *see* TEMPERATURE.

The use of the thermometer for estimating the temperature of rooms, and especially of wards, is fully described in other appropriate articles. *See* NURSING THE SICK; and PERSONAL HEALTH. C. G. H. BÄUMLER.

THIRD NERVE, Diseases of.—INTRODUCTION.—The third nerve is purely motor in function. It supplies the levator palpebræ superioris; the superior, inferior, and internal recti; the inferior oblique; and the ciliary muscle and the sphincter of the iris. It arises from the surface of the crus cerebri by a series of fasciculi, proceeding from a nucleus of grey matter which lies beneath the hinder part of the floor of the third ventricle and the aqueduct of Sylvius, and is continuous behind with the nucleus for the 'fourth' nerve. From the experiments of Hensen and Voelcker, and some limited facts observed in man, there seems to be a serial representation of the several functions of the two nerves in this tract of grey matter. The anterior portion innervates the ciliary muscle subserving accommodation; next is the centre for the sphincter of the iris, through which contraction of the pupil is produced. Behind these centres for the internal muscles are, successively: those for the levator palpebræ; the rectus superior; while that for the internal rectus is probably by the side of the latter; farther back are centres for the inferior rectus and inferior oblique, while behind the former is the centre for the superior oblique (fourth nerve), associated in function with the inferior rectus. It is probable that the series of separate roots of the third nerve corresponds to this series of centres and of functions. We do not yet know whether the associated actions in convergence, and those of the lateral movements of the two eyeballs, are arranged in this nucleus or in adjacent centres. The fibres for the internal rectus seem to pass up to the nucleus of the third nerve from that of the sixth—those fibres for the internal rectus that are concerned in the conjoined lateral movement.

Description.—Morbid states of the third nerve are revealed by (1) Spasm, or (2) Paralysis in the muscles supplied by it, that is, those of the eyeball and the upper eyelid; in the iris; and in the ciliary muscle.

1. Spasm.—Spasm is never met with at the same time in all the muscles supplied by the third nerve. It involves isolated ocular muscles, especially in the internal rectus, in conditions of irritation of the trunk and nucleus of the nerve, as in meningitis, in hysteria, also in hypermetropia, and in paralysis of the antagonist muscle. When extreme, the eyeball is turned inwards, and cannot be moved out. Clonic spasm of the muscles occurs in 'nystagmus,' which may be present only during voluntary effort, or may be spontaneous. The elevator of the upper eyelid is occasionally spasmodically contracted, so that the eye cannot be shut, but remains widely or partly open (*lagophthalmos*). Some degree of this elevation is common in exophthalmic goître, and may occur alone, as a partial manifestation of a similar state. Slight contraction of this muscle occurs also in cases of long-continued paralysis of the orbicularis palpebrarum. Spasm of the levator may also be due, in rare cases, to peripheral irritation in the region of the fifth nerve.

Contraction of the sphincter of the iris produces diminution of the pupil (*myosis*), sometimes to very small dimensions. It may result from irritation of the trunk of the third nerve; or from stimulation, central or reflex, of the nucleus; or it may be secondary to paralysis of the dilator fibres supplied by the sympathetic. It may result from excessive (associated) efforts at accommodation. It is, however, most frequently met with in locomotor ataxy, and is associated with loss of reflex action. The condition is described more fully in the next section. Spasm of the ciliary muscle may result from the other causes of irritation of the nerve-trunk, or from excessive efforts at accommodation in hypermetropia. Its effect is to produce a fixed accommodation for near objects.

Treatment.—The treatment of the central causes of overaction of the third nerve commonly resolves itself into that of the primary condition. Rest is important, and attempts to converge and accommodate should be, as far as possible, avoided. If no exciting cause can be discovered, the overaction should be reduced by sedatives, of which bromide of potassium is the safest. Sometimes belladonna may be added with advantage, but its effect should be watched. It is needless to say that distinct errors of refraction should be corrected by glasses. When a peripheral source of reflex excitation can be ascertained, its influence may be lessened by injections of morphine or cocaine. Functional overaction is often the expression of weakness, and needs nervine tonics in addition to the other measures. Counter-irritation, in the region of the related sensory nerve, is frequently of great service in this as in most other forms of functional spasm. Persistent convergence in hysteria can generally be removed by a small blister to each temple. Atropine will overcome spasm of the sphincter pupillæ or of the ciliary muscle. The cold douche to the eyeball is useful in spasmodic lagophthalmos, but many cases of this affection are extremely obstinate. The treatment of the retarded descent of the lid occurring in exophthalmic goître, and now and then met with as an isolated symptom (or combined only with a quick pulse), is that of this disease as a whole.

2. Paralysis. — Ætiology. — The commonest cause of paralysis of the third nerve is some affection of its trunk as it passes through the membranes at the base of the brain, through the orbital fissure, or along the orbit; due either to rheumatic inflammation of the nerve-sheath, to syphilitic inflammation of the nerve or membranes, or very frequently to injuries of various kinds. Less frequent causes are acute lesions—hæmorrhage, softening, inflammation—in the nucleus of the nerve, or at the inner part of the crus cerebri through which the fibres pass and from which they emerge; compression of this part by an aneurysm or a growth in the interpeduncular space; basilar meningitis; and aneurysm of the termination of the internal carotid. A syphilitic growth, on the nerve or near it, may compress the fibres. Paralysis is also met with as a result of diphtheria, and in association with disease of the spinal cord, especially locomotor ataxy. It occurs also, in rare cases, as part of multiple neuritis after other acute specific diseases besides diphtheria, and from some toxic substances. Sudden palsy of a branch, occurring during effort, is probably due to an extravasation in the sheath of the nerve.

Two peculiar causal varieties deserve mention. In *relapsing palsy* the nerve on one side becomes paralysed subacutely, the whole, or more commonly some, of its branches suffering; it recovers imperfectly; and then the other nerve becomes similarly affected. Afterwards the palsy of the first returns, and some permanent affection of both nerves remains. This form is met with in the subjects of old syphilis. *Periodical* or *recurring palsy* is a peculiar variety, perhaps allied to migraine, in which transient palsy of the third nerve occurs at intervals during many years, sometimes even from childhood up to adult life.

Occasionally all the muscles supplied by the third nerve become paralysed, together with the other orbital muscles—'ophthalmoplegia externa'—from degeneration of the cells of the nuclei of these nerves; and hence it is also termed 'chronic nuclear palsy.' This is usually due to alterations in the grey matter similar to those which, in the spinal cord, gives rise to progressive muscular atrophy. It is perhaps in some instances due to peripheral degeneration of the nerves. It is met with in association with tabes, and also alone; and in both cases is most common in the subjects of syphilis, being met with in both the acquired and inherited forms.

Symptoms.—Paralysis may affect some or all of the fibres of the third nerve. When complete, the upper eyelid is dropped and cannot be raised, and the eye can be moved only outwards, and a little outwards and downwards; after a short time it is always turned outwards. The pupil is in a mid-state between contraction and dilatation, and cannot be made to contract by light; power of accommodation in the eye is lost, owing to paralysis of the ciliary muscle. Each muscle supplied by the nerve may be paralysed separately, by an affection of its special branch of the nerve after it leaves the main trunk.

When the levator palpebræ superioris is affected, *ptosis*, or dropping of the eyelid, alone results. It is seldom an isolated symptom of disease of the third nerve, since the branch to the levator is seldom alone affected; but it occurs, with palsy of the associated superior rectus, from limited disease of the nucleus. It is met with in partial disease of the nerve from all the causes of this. It is also congenital. A form of 'morning ptosis' sometimes occurs, owing to a difficulty in raising the lids on first waking. In hysteria, ptosis may be simulated by contraction of the orbicularis, a mechanism which becomes distinct if contraction of the corresponding half of the occipito-frontalis is induced by making the patient look up.

Paralysis of one of the three straight muscles supplied by the third nerve is indicated by symptoms which occur chiefly during movements in which the paralysed muscle is needed; they are the series of symptoms that result from paralysis of any ocular muscle, and which are elsewhere described in detail—limitation of movement, primary deviation, strabismus, secondary deviation of the unaffected eye, diplopia, erroneous projection of the field of vision, and often vertigo as the result of the last. In diplopia the distance between the two images increases as the object is moved in the direction of action of the affected muscle. When the internal rectus is paralysed, slight power of movement inwards still remains from the superior and inferior recti. There is divergent strabismus and crossed diplopia, when looking upwards and inwards the images approach at the top, when looking downwards and inwards they approach at the bottom. The patient carries his head turned towards the side of the affected muscle, to avoid the double vision. When the superior rectus alone is paralysed, the movement upwards of the affected eye is diminished, and the eye deviates a little outwards; there is crossed diplopia in the upper half of the visual field, the image formed by the affected eye being higher than the other, the two diverging above, the difference in height being greater in looking outwards and upwards, while the difference in obliquity is greater on looking inwards and upwards. When the inferior rectus only is affected there is defective movement, with crossed diplopia, on looking downwards. The second image is below that of the healthy eye, the distance between them being greatest on looking downwards and a little inwards. The images are not parallel, but diverge at the bottom, and the difference in obliquity increases on looking inwards and downwards. The inferior oblique is very rarely affected alone.

In paralysis of the sphincter iridis, the elasticity of the structure maintains the pupil at middle size, and it can be further dilated by atropine, but all power of contraction beyond that degree is lost. When the ciliary muscle is paralysed, the power of accommodation is lost: the far point of vision remains the same, but the near point is rendered much more distant.

The remarkable loss of reflex action of the iris, which occurs in association with locomotor ataxy, is often accompanied by myosis. Then, the pupil does not dilate on stimulation of the skin (Erb). When the pupil is not small, this reflex dilatation is usually preserved. In loss of the light-reflex the contraction on accommodation and convergence is often preserved (Argyll-Robertson). Sometimes this is also lost, the ciliary muscle being paralysed—the 'ophthalmoplegia interna' of Hutchinson. Power of accommodation may be lost although the pupil still contracts on an effort at accommodation. These symptoms also occur in cases of old syphilis, apart from spinal disease. They probably then depend on limited degeneration in the nuclei of the third nerve, the result of the action of some poison left by the organised virus of syphilis.

Diagnosis.—Paralysis of the third nerve is generally obvious: only the slighter palsy of separate branches supplying the ocular muscles is sometimes not easy to recognise; and for this purpose, a careful examination of the double images is often necessary. The diagnosis of the cause is less easy. Rheumatic paralysis succeeds exposure to cold, and is often attended by much pain; in syphilis other cranial nerves are often affected independently; in meningeal and spinal disease there are the respective distinctive symptoms; in disease of the crus there is hemiplegia of the opposite side, coincident in onset with the affection of the third nerve; in interpeduncular disease the affection of the third nerve may precede the hemiplegia, and both third nerves commonly suffer. After diphtheria the ciliary muscle is usually alone affected. In the pseudo-ptosis of hysteria, the contraction of the orbicularis can be rendered evident by making the patient try to look up; the contraction of the levator has to be counteracted by conspicuous contraction of the orbicularis.

Prognosis.—When due to cold or to recent syphilitic mischief, or occurring after diphtheria, the prognosis of paralysis of the third nerve is good if proper treatment can be secured. In cases of organic cerebral disease it is less favourable, and is subordinated to that of its cause. In association with spinal disease the ultimate prognosis is unfavourable, for, although the early attacks are usually recovered from, the affection often recurs, and each recurrence leaves some residual effect. As a general rule, however, the prognosis must be guided by the nature of the morbid process on which the palsy depends, the extent to which this can be influenced by treatment, and the duration of the changes in the nerve-elements on which the symptoms directly depend.

Treatment.—In rheumatic paralysis of the third nerve from cold, hot fomentations, counter-irritation by blisters to the temple, with an alkaline diuretic or salicylates, should be employed in the early stage. In all forms of acute or subacute inflammation it is wise to give small repeated doses of mercury. Subsequently small doses of iodide of potassium and tonics are the most useful. When it is of syphilitic origin, large doses of iodide of potassium usually suffice to effect a cure. If associated with spinal mischief, strychnine, iron, and arsenic are occasionally of some service. In intracranial disease—tumour, aneurysm, or meningitis—the treatment is that of its cause. After diphtheria tonics are alone necessary; it is indeed a merely subordinate symptom in most cases. In paralysis of the sphincter pupillæ and ciliary muscle, occasional instillation of a small quantity of solution of eserine does good, by stimulating locally the paralysed fibres, and this has been said to be beneficial in affections of other branches of the nerve. In the paralysis of the ocular muscles electricity has been recommended, applied through the eyelid to the affected muscle, a small electrode being used, and the eye so turned as to bring the muscle as much as possible within reach, the other electrode being placed on the temple. A direct application to the conjunctiva is too painful. But whether faradism or voltaism is used, the evidence of benefit, when the facts are rigidly scrutinised, is practically *nil*. The only 'satisfactory' results have been in syphilitic cases in which iodide of potassium was also given. The application of the continuous current in the neighbourhood of the orbit sometimes produces slight temporary increase of power, when there is only weakness, but the effect is produced merely by the stimulation of the sensory nerves, and is never enduring.

W. R. Gowers.

THIRST.—Synon.: Fr. *Soif*; Ger. *Durst.*—Thirst is a sensation indicating a necessity on the part of the system for an increased supply of water, as appetite shows there is a need for the introduction of food. Although the sensation is referred to the back of the throat, it is not a purely local feeling, as is proved by the fact, well known to physiologists, that it cannot be allayed by the swallowing of water, unless the fluid reach the stomach and be absorbed. It is always present in febrile disorders, an increased supply of liquid being required both to reduce the heat, by promoting the evaporation of moisture from the skin and lungs, and also to wash away the products of the increased tissue-changes that accompany these complaints. In like manner it is always present when much fluid has been abstracted from the system; thus, it shows itself after all surgical operations attended by hæmorrhage. It is a prominent symptom in cholera and diarrhœa, in which diseases large quantities of serum are rapidly removed from the gastro-intestinal circulation, and equally so in diabetes mellitus, where fluid is largely excreted along with sugar by the urinary organs. A craving for cold and acid drinks presents itself in acute gastritis, the intensity of the thirst being perhaps due to the incessant vomiting, which prevents fluids remaining long enough in the stomach to be absorbed. In chronic gastritis thirst is usually present, and is chiefly complained of towards evening. It forms a useful diagnostic sign between this disease and mere atonic dyspepsia.

Treatment.—Thirst is relieved by the agents usually recognised as refrigerants, such as water, barley water, toast and water, and similar drinks; sucking small pieces of ice; effervescing drinks; freely diluted acid drinks, especially those made with vegetable acids or phosphoric acid, alone or combined with a little aromatic bitter; the juices of fruits, or these made into drinks. Care has often to be exercised in the employment of these apparently harmless agents, and their consumption has to be checked, otherwise patients will take them to excess, and may thus do themselves considerable injury.

Samuel Fenwick.

THORACENTESIS: THORACOCENTESIS (more correctly), (*θώραξ*, the chest; and *κεντέω*, I prick).—Synonyms for paracentesis thoracis, or tapping of the chest. *See* Paracentesis; and Pleura, Diseases of.

THORACIC ANEURYSM.—Under this head are included aneurysms of (A) the Intra-Thoracic Aorta; (B) the Arteria Innominata; (C) the Pulmonary Artery; (D) the Coronary Arteries; and (E) the Heart. The last two forms have been fully treated of under their respective articles, and will not be further referred to here. *See* CORONARY ARTERIES, Diseases of; and HEART, Aneurysm of.

A. **Aneurysm of the Intra-Thoracic Aorta.**—This may be most conveniently discussed in its clinical aspects under two heads, namely, (1) *aneurysm of the arch*, and (2) *aneurysm of the descending thoracic aorta*; whilst the former may be subdivided into aneurysm of (*a*) the *ascending*, (*b*) the *transverse*, and (*c*) the *descending* portion.

Relative frequency.—Of seventy-six cases analysed by the late Dr. Hayden, including fourteen treated by him, the seat of aneurysm, single or multiple, stated in the order of relative frequency, was as follows: *Single*: ascending portion of arch, thirty; transverse portion, seventeen; descending thoracic aorta, ten; ascending and transverse portions of arch, nine; transverse and descending portions, two; entire arch, two; descending portion, one; thoracico-abdominal aorta, one. *Multiple*: ascending portion of arch and descending thoracic aorta, two; ascending portion of arch and abdominal aorta, two.

1. **Aneurysm of the Arch.** — The different parts of the arch of the aorta must be considered separately.

(*a*) *Ascending portion.*—ANATOMICAL CHARACTERS.—Aneurysms arising from one of the sinuses of Valsalva, within the range of the valves, rarely attain a size larger than that of a billiard-ball. They are saccular and not infrequently pedunculated, communicating with the aorta by a small orifice. They further exhibit a remarkable tendency to *descend* in the progress of growth, involving in their course the heart or the root of the pulmonary artery. By their position they are sheltered from direct influx from the ventricle, whilst they are exposed to the maximum force of reflux from the aorta. When, however, the orifice is partially or entirely above the level of the valves, the main pressure sustained by the sac is that of efflux from the ventricle; hence the direction of growth is upwards. Aneurysm of the portion of the vessel immediately above the level of the valves is especially prone to advance towards the right side, forming a tumour visibly projecting, or detectable by palpation and percussion, in the vicinity of the right nipple. It may be fusiform or saccular, true or false; it usually attains a large size; and, when fusiform, not infrequently extends over a great portion or even the whole of the arch. The direction of growth may, however, be backwards or to either side; the aneurysm in its progress implicating the œsophagus, the pulmonary artery or one of its branches, the superior vena cava, or either auricle; it is in such cases usually saccular, and of comparatively small size. Aneurysms of the extra-pericardial portion of the ascending aorta usually tend forwards and upwards in the line of main blood-pressure, projecting at the right margin of the sternum above the fourth costal cartilage, and occasionally likewise into the root of the neck, involving the arteria innominata. They may, however, grow backwards and to the right, implicating the right bronchus or lung, or the superior cava; directly backwards, pressing upon the œsophagus or the bifurcation of the trachea; or, projecting mainly towards the left side, they may involve the left branch of the pulmonary artery, and the left bronchus or lung.

SYMPTOMS AND SIGNS.—Aneurysm of the sinuses is rarely attended with very definite symptoms; indeed, only when it presents at the anterior wall of the chest.

Owing to its position within the pericardium, and its close proximity to the heart, the symptoms produced by aneurysm in this situation may be readily confounded with structural or valvular disease of the heart itself. The acoustic signs are, for the purposes of diagnosis, no less indefinite; because, from the position of the aneurysm close to the orifice of the aorta, a murmur produced by it, whether of influx or of efflux, may be easily mistaken for one of the same rhythm caused by obstruction at the aortic orifice or inadequacy of the valves. The difficulty of diagnosis is further increased by the usual co-existence of atheroma with dilatation of the first portion of the aorta, relative incompetency of the valves, and eccentric hypertrophy of the left ventricle. The ordinary symptoms are those of palpitation and derangement of the rhythm of the heart, from affection of the cardiac plexus. But the diseases just mentioned may, in the absence of aneurysm, give rise to similar phenomena. The existence of venous stasis and congestion of the upper half of the body, viewed in conjunction with tumultuous and irregular action of the heart, and in the absence of discoverable cause of venous obstruction at a higher point in the chest, would, however, warrant the *presumptive* diagnosis of aneurysm at the root of the aorta, implicating the right auricle or the termination of the superior cava; and if with these symptoms were associated systolic murmur at the base, not transmitted in the course of the aorta, or a double murmur, a positive diagnosis to the above effect might be made. Were the diastolic murmur preceded by a distinct second sound, valvular inadequacy from dilatation of the aorta, without valvular disease, would be thereby indicated, and the diagnosis of aneurysm *pro tanto* sustained. Symptoms of obstruction of both cavæ, namely, general venous congestion and engorgement of the liver, would in the foregoing connexion justify the special diagnosis of pressure upon the sinus of the right auricle. The symptoms of pressure upon the other chambers of the heart are those only of deranged rhythm and circulation, such as may be due to various causes inherent in the heart. Systolic murmur in the pulmonary artery may result from the pressure of an aneurysm on the root of that vessel. Communication of an aneurysm with one of the chambers of the heart is usually effected by an aperture not more than two to three lines in diameter. It is the result of progressive absorption, and the symptoms are scarcely to be distinguished from those of antecedent pressure. The physical signs are more characteristic; they consist in a loud murmur, systolic or diastolic, of a 'booming' or 'splashing' character, accompanied by thrill, traceable from the root of the aorta in the direction of abnormal influx, and not transmitted in any of the ordinary lines of valvular murmur. If two murmurs exist, they are fused or converted into a continuous rumble. Sudden transfer of the seat of greatest intensity of such a murmur, from the aortic area to some other point of the præcordia, would be conclusive, not only as to the irruption of an aneurysm into one of the chambers of the heart, but likewise as to the date of its occurrence. The sac of an aneurysm in the situation of the aortic sinuses does not attain any considerable size, as it usually bursts into the pericardium, thus causing sudden death.

Aneurysm of the ascending aorta, external to the pericardium, is occasionally latent, but ordinarily it is characterised by very definite symptoms and signs. A large fusiform aneurysm of this portion of the vessel, or one engaging the entire arch, equally expanded, not in contact with the anterior thoracic wall or pressing inconveniently upon any of the adjacent organs, may be virtually latent; exhibiting no symptoms of aneurysm except vague neuralgic pains darting over the chest, shoulders, arms, and back, and no sign but exaggerated double sound. Pointing externally, or in persistent contact with the chest-wall, an aneurysm may be readily identified by the circumstance that it presents a second centre of pulsation and intensified sounds. The ordinary pulsation is systolic, expansile, and diffused (though not always equally) over the entire surface; but a second and minor impulse of diastolic rhythm may likewise exist. The former is in many cases accompanied by tactile thrill. The acoustic signs consist either in two sharply accentuated sounds, nearly alike in character, and corresponding in rhythm to those of the heart; or in a single or double murmur of blowing or 'booming' quality. There is likewise absolute dulness, with suppression of respiratory sounds and of vocal fremitus, to the extent of the tumour.

Pressure upon the superior cava is characterised by venous congestion, limited to the upper half of the body: whilst actual communication with that vessel is evinced by cyanosis to the same extent; extreme engorgement with pulsation of the jugular veins; a buzzing systolic murmur; and intense thrill, at the seat of communication and transmitted into the veins of the neck. According to the late Dr. Mahomed, in cases of arterio-venous aneurysm *inspiration* alters the characters of a sphygmogram, by diminishing the volume of blood in the artery. Pressure upon the main bronchus is indicated by diminished or suppressed respiration, with normal percussion-sound, in the corresponding lung; and occasionally by 'whiffing' or 'jerking' inspiratory sound. Diminished respiration throughout either lung, with inequality as between its upper and lower portions, would indicate pressure, but unequal in degree, upon the primary bronchus and its superior secondary branch; whilst partial or complete suppression confined to the upper lobe would show that the superior lobular branch was alone implicated. Pneumonia from occlusion of the pulmonary vessels, or from pressure upon the pneumogastric or pulmonary plexuses, is a frequent result of the pressure of an aneurysm. The consolidation of lung-substance so produced is due to implication of the laryngeal and pharyngeal nerves. Bronchitis may likewise arise from mechanical irritation; and where present may, in greater or less degree, mask the physical signs of aneurysm. The sudden irruption of an aneurysm into one of the bronchi is indicated by copious discharge of florid blood from the mouth and nostrils, and is instantly fatal by syncope or asphyxia. An opening established into the pulmonary substance is followed by 'leakage' of blood, or repeated but limited hæmoptysis. Pressure upon the pulmonary artery is necessarily attended with engorgement of the right chambers of the heart, and general venous congestion; and the establishment of an opening into that vessel, with sudden and urgent dyspnœa without spasm or stridor, extreme congestion of the lung, and hæmoptysis. Death is rapid in such cases; but should an opportunity for physical exploration be afforded, a 'buzzing' systolic hum might be detected in the second and third left intercostal spaces, close to the sternum. Pressure upon the œsophagus is indicated by dysphagia, referred by the patient to a corresponding point of the chest. Dysphagia due to the pressure of an aneurysm is remittent, and varies in some degree with posture—traits by which it is distinguished from that produced by cancer. Dysphagia from volvulus of the œsophagus may, however, exhibit similar variations.

(*b*) *Transverse portion.*—ANATOMICAL CHARACTERS.—Aneurysms of this portion of the aorta are usually fusiform: they involve mainly its anterior and superior wall, pushing forward the upper end of the sternum, projecting into the neck, compressing the left innominate vein, and modifying, in many cases, the circulation in the primary arteries and their branches. They likewise frequently press backwards upon the œsophagus and trachea, the pneumogastric or sympathetic of either side, or the left recurrent nerve. Owing to the backward course of the left extremity of the arch, aneurysms arising from this portion of the vessel rarely appear in front. They project above the left clavicle, involving the innominate vein, the pneumogastric, sympathetic, or recurrent nerve of the left side, and occasionally all three; or posteriorly in the left scapular region.

SYMPTOMS AND SIGNS.—Pressure upon the left innominate vein is accompanied by visible engorgement of the thyroid, left jugular, subclavian, brachial, and superficial thoracic veins and their tributaries, with œdema of the left arm. The circulation in the carotid or subclavian artery of one side is often diminished or suppressed by the lateral pressure of an aneurysm, or by clot formation in the sac. Pressure upon the trachea is indicated by clanging or metallic cough, and stridor 'from below,' that is, loudest at the upper part of the sternum, and distinctly audible over the lower cervical and upper dorsal vertebræ. The symptoms of aneurysmal pressure upon the sympathetic, pneumogastric, and recurrent nerves are most frequently exhibited on the left side only. Those due to implication of the sympathetic or its cilio-motor roots are manifested in the pupil on the affected side. They consist in dilatation or contraction of the pupil according to the degree of pressure; the former from irritation, and the latter, which is the more usual phenomenon, from paresis of the nerve. Laryngeal stridor, huskiness or loss of voice, and harsh metallic cough, in the absence of local disease of the larynx, are eminently diagnostic of pressure upon either recurrent nerve. By means of the laryngoscope the vocal cord on the side of disease, and in rare cases the cords on both sides, are seen to be fixed during breathing and vocalisation, from unilateral or bilateral paralysis of the abductor muscles of the larynx. Sir George Johnson holds that unilateral paralysis is distinguished by slight huskiness of voice, with stridor on full inspiration; and bilateral paralysis, by permanent dyspnœa and stridor. Paroxysmal dyspnœa or fatal asphyxia may result from collapse of the arytænoid cartilages in such cases. Pressure upon either pneumogastric is especially characterised by paroxysms of remittent spasm of the glottis, which may be suddenly fatal; but, where the recurrent nerve is not likewise implicated, persistent stridulous breathing, aphonia, and metallic cough are not exhibited. A marked difference in the volume of the pulse at the wrists is frequently noted in aneurysm involving the innominate or subclavian arteries.

The physical signs are identical with those already described in connexion with aneurysm of the ascending portion of the vessel.

(*c*) *Descending portion.*—ANATOMICAL CHARACTERS.—Aneurysm of the left curvature and descending portion of the arch involves the left recurrent nerve in nearly every instance. In the progress of growth it passes into the root of the neck; backwards towards the left scapula; or backwards and outwards into the substance of the lung.

SYMPTOMS AND SIGNS. — These include symptoms of pressure upon the recurrent or pneumogastric nerve, as well as the subclavian or internal jugular vein; a pulsating tumour in the left interscapular space, which may attain very large proportions; and signs of congestion and consolidation of the upper and back part of the left lung. In the last case the aneurysm, being involved in the pulmonary structure, may afford no specific evidence of its existence.

The physical signs differ in no respect from those which characterise aneurysm of the other portions of the arch.

2. Descending Thoracic Aorta. — ANATOMICAL CHARACTERS.—Aneurysms of the upper portion of this division of the vessel rarely attain a large size. They may pass upwards and to the right side, implicating the trachea and œsophagus; or directly to the right, stretching the œsophagus or thoracic duct, and ultimately opening into one of them, or into the right pleura. In a case which came under Dr. Hayden's notice, the trachea and the œsophagus were simultaneously perforated, and death occurred by hæmorrhage into both. The aneurysm may advance to the left, and ultimately prove fatal by rupture into the left pleural cavity; it may erode the vertebræ and ribs, opening into the spinal canal, causing paraplegia; it may point in the left infrascapular region; or it may advance towards the anterior wall of the chest, displacing the heart, and involving itself in the substance of the left lung. Aneurysm of the lower part of the vessel usually extends into the abdomen, constituting the thoracico-abdominal form of the disease. It may displace the heart forwards, and the liver downwards; it may likewise extend backwards, eroding the vertebræ, and pointing in the lower dorsal or the lumbar region on the left side. Finally, an aneurysm in this situation may prove fatal by simultaneous hæmorrhage into the left pleural cavity and left retroperitoneal space, or into the vertebral canal.

Symptoms and Signs.—To what has been already stated on this subject it is only necessary to add, that progressive absorption of the vertebræ is indicated by fixed and boring pain referred to a particular point of the vertebral column, which is tender to pressure, or not infrequently radiating or 'nipping' pains extend round the chest from implication of the intercostal nerves. Forward displacement of the heart by an aneurysm would be characterised by violent impulse, simulating that of cardiac hypertrophy (the distinction would rest upon the presence of the special symptoms and signs of aneurysm); a remarkable derangement of cardiac impulse, constituting the 'double jog' of Hope; with absence of the positive signs of hypertrophy. Pressure upon the thoracic duct is very rare; it would be indicated by the symptoms of mal-assimilation, wasting, and inanition—symptoms which are foreign to aneurysm under its ordinary forms.

The physical signs of aneurysm of the descending thoracic aorta are ordinarily limited to a sharp sound, single or double, audible over the dorsal vertebræ and somewhat to the left; and, more rarely, perceptible impulse. The existence of murmur is exceptional; when present, murmur is all but invariably single and post-systolic, and is inaudible in the erect posture.

Duration and Terminations.—The duration of aneurysm of the intra-thoracic aorta may vary from a few days to several years. Death is most frequently caused by rupture of the sac into various parts; or by gradual exhaustion from insomnia and inanition. Of seventy-one cases of aneurysm in this situation tabulated by Dr. Hayden, including twelve observed by him, twenty-six were fatal by rupture of the sac; namely, into the pericardium ten—all being aneurysms of the ascending aorta; into the left lung or pleura five—four being of the transverse, and one of the descending thoracic aorta; into the trachea four—three of the transverse, and one of the ascending aorta; into the right lung or pleura three—two of the ascending, and one of the descending thoracic aorta; into the left bronchus or œsophagus three—two of the descending thoracic, and one of the transverse aorta (in one of these an opening existed both into the left bronchus and the œsophagus); externally one—the aneurysm having arisen from the transverse aorta. Death may also result from asphyxia, from intercurrent inflammation of the lungs or pleura, or from coma.

B. Aneurysm of the Arteria Innominata.

B. Aneurysm of the Arteria Innominata.—Aneurysm involving the innominate artery may be mistaken for aneurysm of the aorta, at or near the first curve of the arch.

Symptoms and Signs.—Those which are most distinctive of innominate aneurysm are the early appearance of pulsating tumour above the right clavicle, accompanied by arterial obstruction on the right side; displacement of the trachea and larynx to the left; and pulsation with accentuated sound, localised at the right sternoclavicular joint and immediately above it. Diminished circulation in the right carotid and subclavian arteries at an early period of the disease, and the reduction or arrest of pulsation in the sac by digital pressure upon these vessels, afford the most constant and least equivocal evidence of innominate aneurysm. The early occurrence of neuralgic pains in the right side of the neck, the right shoulder, and ear, followed by œdema and partial paralysis of the right arm, is likewise suggestive of innominate, as distinguished from aortic aneurysm. The symptoms of nerve-pressure on the right side, as exhibited in the larynx and pupil, are usually well-pronounced in this disease. The physical signs are in no respect different from those of aneurysm of the arch. Concurrent implication of the aorta is ordinarily determined with the greatest difficulty, and occasionally a positive diagnosis in this respect cannot be made. If pulsation and sound of maximal intensity exist at the level of the second costal cartilage, or an inch and a-half below the sternal end of the clavicle, whilst the pulse-tracing of the right radial artery exhibits imperfect aneurysmal characters, the aorta may be considered as involved in the disease.

C. Aneurysm of the Pulmonary Artery.—Aneurysm of the main trunk or primary branches of the pulmonary artery is unknown; but aneurysm and ectasia of the secondary and subsequent branches have been repeatedly found in connexion with cavities in the lungs, and are recognised as the ordinary source of fatal hæmoptysis in the third stage of phthisis. Cavities confined to one lung with walls condensed by fibroid growth, and either stationary or in process of secondary ulceration, are those which are most favourable to the formation of pulmonary aneurysm or ectasia. In the walls or trabeculæ of such cavities the branches of the pulmonary artery remain pervious; their coats, already thickened by chronic inflammation, and weakened by degenerative changes, expand under vascular pressure, where least supported, and form an aneurysm, globular, fusiform, or semi-fusiform, according to the extent and degree of their structural change and denudation, or a simple ectasia. These ultimately give way by rupture or erosion, and severe hæmorrhage into the cavity and connected bronchi is the immediate result. Active ulceration of an existing cavity is usually attended with partial thrombosis of adjacent vessels. Hence, in such cases, hæmoptysis is seldom copious, and death results from exhaustion produced by repeated small hæmorrhages. In the process of primary and active excavation of lung-tissue the vessels are completely blocked, and hæmoptysis, even to a small amount, is exceptional. *See* HÆMOPTYSIS.

SYMPTOMS AND SIGNS.—Of a special kind there are absolutely none. Copious hæmoptysis in connexion with cavity would be eminently suggestive of pulmonary aneurysm. Of twelve cases of fatal hæmoptysis in the third stage of phthisis, tabulated by Dr. Douglas Powell, a ruptured aneurysm or ectasia of a pulmonary branch was found to be the source of hæmorrhage in no less than eleven instances.

TREATMENT.—The treatment of aneurysm will be found described in the articles ABDOMINAL ANEURYSM; and AORTA, Diseases of. The *curative* treatment of aortic or innominate aneurysm should be directed to the single object of effecting consolidation of the contents of the sac. With this object in view, three methods have been pursued, either separately or conjointly, namely, the *postural* and *dietetic*; the *medicinal*; and the *operative*. As complemental of the first plan of treatment of thoracic aneurysm, an occasional blood-letting by venesection, to the amount of eight to ten ounces, for the purpose of reducing arterial tension or venous engorgement, may be demanded. With a view to causing or promoting deposition of fibrin in the sac, several agents have been used, namely, acetate of lead, in doses of four to eight grains; iodide of potassium, ten to thirty grains; and aconite, five minims of the tincture thrice daily. Ergotin has been used hypodermically by Langenbeck. Each of these agents has been credited with success in the treatment of aneurysm. But, as spontaneous cure has been occasionally witnessed under favourable circumstances as to diet and rest, where no medicine had been given, a more than promotive influence, by retarding the circulation and reducing vascular pressure, can scarcely be assigned to the medicine used, where rest and restricted diet have been observed. Galvano-puncture of the sac has been practised with success. Deligation of the common carotid artery, or of that vessel and the subclavian, may be followed by the most favourable result, in cases where pressure upon these vessels has been found to control pulsation in the sac. For details of the operative treatment of aneurysm the reader is referred to works on surgery and to the article on ANEURYSM.

The *palliative* treatment of thoracic aneurysm is discussed in the article AORTA, Diseases of. A few leeches applied from time to time in the vicinity of the sac, or a hypodermic injection of morphine or hydrochlorate of cocaine, will relieve the pain and allay the inflammation caused by excentric pressure.

THOMAS HAYDEN. C. J. NIXON.

THORACIC DUCT, Diseases of.—SYNON.: Fr. *Maladies du Canal Thoracique*; Ger. *Krankheiten des Ductus Thoracicus.*—The thoracic duct is the main trunk belonging to the absorbent system, by means of which the chyle from the lacteals, and the lymph from the lymphatics (except that from the right side of the chest, neck and head, and the right arm), are conveyed into the circulatory system, so that these fluids may be mixed with the blood. It starts from the receptaculum chyli, deep in the upper part of the abdominal cavity; passes through the aortic opening of the diaphragm, on the right of the aorta; accompanies this vessel along the thoracic cavity; passes beneath its arch and the left subclavian artery; then along the left side of the œsophagus; and, finally, comes forward in the neck from behind the left carotid artery, arching over the subclavian artery, and crossing the phrenic nerve and anterior scalenus muscle, to open usually into the left subclavian vein, near its junction with the internal jugular. These facts enable us to understand how the chief morbid conditions of the thoracic duct are produced.

The diseases of the thoracic duct resemble in kind those of the absorbent vessels generally (*see* LYMPHATIC SYSTEM, Diseases of); and it will suffice to indicate here the following practical points: (1) The passage of fluid along the duct, and its escape into the subclavian vein may be impeded by any condition which interferes seriously with the venous circulation, and distends the veins considerably, such as certain cardiac diseases. (2) Local obstruction of the thoracic duct may arise at any point, from direct pressure upon it, especially by an aortic aneurysm, and it may become thus permanently occluded; or from intrinsic tubercular disease, which is of special importance (*see* Memoir by Stilling, Virchow's *Archiv*, and *Lancet*, vol. i. 1882). (3) As a consequence, dilatation of the portion of the tube behind the seat of obstruction will probably supervene in various degrees, and it may become considerably enlarged and thickened. The portion beyond tends to become contracted and atrophied. (4) Perforation of the thoracic duct occurs in exceptional instances, owing to the destructive effects of an aneurysm or other morbid condition, or as the result of injury.

It is, as a rule, quite impossible to determine during life that the thoracic duct is diseased. This might be suspected if, along with some known cause which might lead to obstruction of the tube, the patient became extremely emaciated, anæmic, and weak, without other obvious reasons to account for these symptoms. No treatment directed immediately to the thoracic duct can be practicable under any circumstances.

FREDERICK T. ROBERTS.

THORACIC TUMOUR.—A tumour within the chest. *See* Bronchial Glands, Diseases of; Lungs, Malignant Disease of; Mediastinum, Diseases of; and Thoracic Aneurysm.

THORAX, Diseases of.—*See* Chest, Diseases of; Chest-walls, Diseases of; and Chest, Deformities of.

THORAX, Examination of.—*See* Physical Examination.

THREAD-WORM.—*See* Entozoa.

THROAT, Diseases of. — Synon.: Fr. *Maladies de la Gorge*; Ger. *Rachenkrankheiten.*

The throat is a comprehensive term, its diseases including those of the pharynx, tonsils, palate, and uvula, and in popular language even those of the larynx and trachea. The principal affections of these different structures are described in their appropriate articles, to which the reader is referred, and here it will only be necessary to offer a few general remarks on throat-diseases. In many instances all the parts are more or less involved in the morbid conditions present, but in other cases one structure is mainly or exclusively involved. Moreover, the throat may be interfered with by neighbouring diseases, such as retropharyngeal abscess, and some affections of the neck.

Summary of Diseases.—The affections of the throat may be thus grouped in a general way: (1) There may be no actual disease, but the patient merely complains of various sensations referred to the region, these being of a nervous character. (2) The throat is liable to injury by substances swallowed. (3) This part is obviously affected in certain general diseases, especially some of the acute specific diseases. Thus it is particularly involved in scarlatina and diphtheria, and to a less degree in measles, Rötheln, influenza, and general catarrh. Syphilis also implicates the throat in its various stages. This region is sometimes attacked by erysipelas, small-pox, herpes, or thrush. (4) Acute congestion and various forms of acute inflammation, affecting different structures of the throat, are of common occurrence, resulting from causes acting either locally or generally. The cases present much diversity in their severity, depending upon the extent, seat, and terminations of the inflammation. (5) Chronic congestion and inflammation are also not uncommon, of various degrees, and producing different effects in different cases. (6) Ulcerations of the throat are of frequent occurrence, being usually dependent on some general condition, such as syphilis, scarlatina, or diphtheria; but sometimes purely local in their origin. They may become sloughy or gangrenous, causing much destruction of the tissues, or even opening up vessels, and thus proving fatal by hæmorrhage. The after-effects of ulceration may be evident in the way of cicatrices or bands, contraction, adhesions, and permanent loss of parts. (7) The structures in the throat are very liable to become relaxed, and thus to produce symptoms, especially the uvula. (8) The throat may be occupied by some enlargement or morbid growth. Here may be mentioned chronic enlargement or so-called hypertrophy of the tonsils, which, however, is usually the result of chronic inflammation, congestion, or, it is said, albuminoid disease. Post-pharyngeal adenoid growths are now believed to be a common cause of trouble in this locality. Cancer and polypi are the more definite tumours usually met with, though very exceptionally, and cancer may proceed to ulceration. (9) Malformations are not uncommonly of importance in connexion with the throat. The size of the pharyngeal cavity varies much in different persons, but its unusual smallness may be of more or less consequence. Deformities of the palate are of much importance, being either congenital or the result of disease. (10) Sensory or motor paralysis involving the throat is sometimes a serious affection. The condition is especially met with after diphtheria, or in cases of labio-glosso-laryngeal paralysis.

Clinical Signs.—The symptoms in throat-affections are very variable, as regards their severity, exact nature, and combinations, but they are more or less of the following nature: (1) Painful or other abnormal sensations are usually complained of. Pain may range from mere 'sore-throat' to marked suffering; and in some instances it is attended with throbbing, or shoots towards the ear. Tenderness is also very common, when anything passes over the surface, or even when the parts are moved in the act of swallowing, and the painful feeling may be only experienced at this time. Talking or coughing is sometimes painful. Tenderness may also be felt when pressure is made over the tonsils from without. Amongst other sensations often complained of are a sense of dryness, irritation, fulness or tightness, heat or burning, obstruction, or the feeling of a foreign body. (2) Not only may the act of deglutition be painful, but in throat-diseases it is often attended with difficulty in various ways, and may be quite impracticable (*see* Deglutition, Disorders of). (3) Articulation is affected in certain conditions, the voice being characteristically altered, and becoming of a thick, guttural, or nasal quality. In other cases it is slightly rough or husky; and, of course, it is likely to be more or less hoarse if the larynx is involved. When the palate is destroyed, the speech is permanently affected. (4) In some forms of throat-disease the breathing is obstructed owing to swollen structures, deposits, or growths filling up more or less the passage of the pharynx. This is especially felt in the recumbent posture; and patients suffering in this way often breathe with the mouth wide open, and snore loudly. The breath may have an unpleasant or even fœtid smell, as the result of morbid states of the throat. (5) Throat-affections frequently excite the acts of hawking or coughing, and various materials are thus expelled in many cases. It may also be mentioned here that some irritation in the pharynx is capable of causing reflex vomiting. (6) Morbid conditions in this part may give rise to hæmorrhage, and this occasionally proves of a serious or even fatal character, as the result of certain destructive lesions. (7) Physical examination of the throat is of essential importance in revealing its morbid conditions. Inspection is usually sufficient, with the aid of a good light, and it is in most cases necessary to depress the tongue by means of the finger, the handle of a spoon, or a tongue-depressor. In some instances it is requisite or more convenient to feel the parts in the throat with the finger. External examination should also be made beneath the angles of the lower jaw. The objective conditions determined by physical examination will depend on the nature of the disease.

Treatment.—For the treatment of the different throat-affections the reader must refer to the articles in which they are respectively discussed. The writer only mentions the subject in order to draw attention to two points, namely: first, the great importance of *general* treatment in a large proportion of cases of affections of the throat; secondly, the necessity of using *local* measures *efficiently*, when these are required; while at the same time it is often most desirable that the parts affected should be kept as much at rest as possible.

Frederick T. Roberts.

THROMBOSIS (*θρόμβος*, a clot).—Synon.: Fr. *Thrombose*; Ger. *Thrombose.*

Definition.—The coagulation of fibrin in the heart, blood-vessels, or lymphatics during life.

Description.—Thrombosis may take place in the heart, the arteries, the capillaries, the veins, and also in the lymphatics. The coagulum consists of fibrin, entangling in its meshes a larger or smaller number of blood-globules, which, in rapidly formed thrombi, consist of both red and white varieties, and hence the thrombus is at first dark-coloured. In slowly formed thrombi, and in those due to projections from the coats of the vessels, the red cells may be absent, and the thrombus is colourless or yellowish-white. In most thrombi the white cells are present in much larger proportion than in normal blood.

When a thrombus occupies the place where coagulation began, it is called a *primitive* thrombus; when it gradually extends from this point along the vessel, an *extension* or *produced* thrombus. This extension usually proceeds along the vessel to its junction with a large branch, into which the thrombus may often be seen to project with a rounded extremity, and this, by obstructing the blood-current, may again form the starting-point for a fresh extension.

Structurally, thrombi may be distinguished as *laminated*, and *non-laminated* or *uniform.* The former result from a process of continuous, the latter from one of intermitting coagulation. In laminated thrombi there is often a layer of white blood-cells between the laminæ, due to the tendency which these bodies have to wander out of the clot.

Thrombi may further be distinguished into *parietal*, or those which adhere to some part of the wall of the vessel; and *obliterating*, or those which completely fill the vessel. Parietal thrombi are generally nearly colourless, and are due to some roughness or other change in the lining membrane. Obliterating thrombi, which are at first coloured, are produced by the sudden coagulation of the blood; the thrombus thus formed shrinks, and leaves a space which again fills with blood; this again coagulates, and so complete obstruction of the vessel is effected. A *post-mortem* coagulum never completely fills the vessel, as, after the shrinking process has taken place, there is no further supply of blood to coagulate. Other points of distinction between *post-mortem* coagula and thrombi are these—the former are never laminated; they are looser in texture, and moister; they do not adhere so closely to the wall of the vessel; and though they may be either coloured or colourless, they never present the appearances due to the subsequent changes which take place in thrombi.

Changes in Thrombi.—The first change observed after the thrombus has shrunken and become denser is *decolorisation.* The colouring-matter dissolves out of the blood-globules, becomes diffused, and is transformed. The thrombus accordingly changes from dark red to tawny, and finally to a yellowish-white; and at the same time it loses its soft elastic texture, and becomes tougher, denser, or even somewhat friable.

The subsequent changes vary. First, a process of *shrinking* and drying up may occur, by which the thrombus gets converted into a tough leathery substance, which may even become calcified, and in this way are formed the concretions in veins known as *phleboliths.*

Secondly, *softening* may take place; this may be due either to a process of molecular disintegration, or more rarely to suppuration. In the former case the thrombus liquefies into a milky fluid, consisting of an oily and granular detritus, the process beginning in the centre. In the heart this change often occurs in the layers of fibrin entangled among the trabeculæ, or in the globular masses which sometimes project from them into the cavities, thus giving rise to the formation of cysts.

Suppuration is occasionally seen in the thrombi of veins surrounded by, or leading from, inflamed parts; a multiplication of leucocytes takes place in the thrombus, either by proliferation or immigration, and the whole softens down into a purulent fluid. In these cases the wall of the vein itself is always inflamed. These softened and broken-down thrombi are a common cause of embolisms.

Lastly, the thrombus may become *organised.* Organisation has been chiefly studied in wounds and ligatures of arteries and veins, and the appearances have been very differently interpreted by different observers. According to one opinion, the thrombus itself becomes organised; the white blood-cells contained in it, or immigrant leucocytes from the vasa vasorum, as proved by including a portion of vein between two ligatures and impregnating the blood with vermilion (Bubnoff), become converted into stellate connective-tissue corpuscles, with interlacing processes; new vessels permeate the clot along the line of the stellate processes from the unobstructed portion of the artery or vein, and form anastomoses with offshoots from the vasa vasorum perforating the tunica intima, which disappears; and thus a vascular reticulated connective tissue is formed, in the meshes of which lie the remains of the red blood-globules and fibrin of the clot. The progressive dilatation of the newly formed vessels gradually renders the thrombus cavernous; and finally, by their coalescence, it entirely disappears, and the vessel again becomes pervious. Cornil and Ranvier dispute the correctness of these observations, and assert that the appearances are really due to the outgrowth, from the tunica intima, of vascular granulations penetrating the thrombus, which gradually disappears without taking any part in the formation of the reticulated connective tissue which is found occupying its place.

Pathology.—According to the views of coagulation now entertained, the formation of fibrin is due to the interaction of two substances present in the blood-plasma: fibrinogen and a ferment (*see* Blood, Morbid Conditions of). The ferment is believed to be contained in the white blood-cells, and is, in all probability, partly derived from these bodies, for in all spontaneously coagulable fluids white blood-cells are present, and where they are absent coagulation does not take place. Even in the blood, when coagulation is retarded, as by keeping horse's blood in a tube formed of the excised jugular vein, it is found that the upper layers, from which the white cells have subsided, coagulate very imperfectly, while a firm clot forms in the lower layers, where the corpuscles are numerous. The white blood-cells also are often seen to form the starting-point from which the threads of fibrin form.

The nature of the process of coagulation is still very obscure. It does not appear to resemble a chemical precipitate.

As the two factors of coagulation, fibrinogen and the ferment, are always present in the healthy blood-plasma, it is evident that there must be some restraining influence which prevents coagulation; and the cause of thrombosis must be looked for in the removal or weakening of this influence. According to Brücke, contact with the healthy lining membrane of the vessels prevents the blood from coagulating; consequently any structural change in this membrane is liable to cause thrombosis. The presence of a foreign body produces the same effect, and a thrombus itself acts as a foreign body. Retardation or arrest of the blood-current is also a common cause of thrombosis. Loss of motion in itself tends to retard coagulation, but free circulation is necessary for the maintenance of the nutrition and integrity both of the vessels and the white blood-cells; hence stagnation tends to cause thrombosis by removing the restraining influence of the healthy vascular wall, and also by setting free the ferment from the white corpuscles; moreover, the motion of the blood maintains the contact between each particle and the lining membrane of the vessels, and so prevents coagulation.

According to many modern observers, an important part in the coagulation of the blood is taken by the bodies, whose exact nature is still undetermined, called blood-*plates* or *plaques.* Eberth and Schimmelbusch find that if the inner coat of a vessel be injured, and at the same time the circulation be retarded, the blood-plates adhere to the injured spot in layers, often entangling among them leucocytes. The blood-plates then become granular, and fuse together into a colourless thrombus, which may block the vessel. To this process they give the name of conglutination, and to this ordinary coagulation may be added. Bizzozero considers that coagulation is produced by the disintegration of the blood-plates, and denies the influence of the white cells; but this is very doubtful.

The principal causes, therefore, of thrombosis are alterations in the lining membrane of the vessels, and retardation or arrest of the circulation; to these may be added the presence of foreign bodies, and probably also the microzymes of septic processes.

Hyperinosis, or increase in the constituents of the fibrin, and diminished fluidity, as in cholera, can only be regarded as predisposing causes requiring retardation of the circulation to take effect.

Retardation of the circulation being one of the most important causes of thrombosis, we find, as might be expected, that its most frequent seat is the veins, where the circulation is naturally feeble.

Varieties. — 1. *Venous.*—The principal causes of venous thrombosis are two. The first of these is wounds and injuries of veins, where the formation of thrombi is the natural way of arresting hæmorrhage. The thrombus may extend along the vein from its primitive seat, and thus cause blocking of venous trunks at a distance from the site of the injury. This is often seen after parturition, when thrombosis of the uterine sinuses may extend to the iliac and femoral veins. Secondly, inflammation of the coats of the vein, by altering the condition of the lining membrane, may cause thrombosis; but in many cases of phlebitis the thrombosis is the primary change, and the inflammation of the coats is set up by it. Other causes of venous thrombosis are pressure on the veins; dilatation; and arrest of the circulation in the capillary territory of the vein, as from embolism or inflammatory stasis. Hence we occasionally find the veins leading from inflamed organs thrombosed. Lastly, thrombosis of the veins is not infrequently due to retardation of the circulation, owing to failure of the propelling power of the heart, in cases of marasmus and exhausting diseases. These thrombi are most frequently met with in the veins of the lower extremities and pelvis, next in the sinuses of the dura mater.

According to Köhler and Hanan many of these marantic thrombi are to be ascribed to an increased formation of ferment, a 'ferment intoxication;' and the local retardation of the circulation only determines the seat of the thrombosis.

2. *Arterial.*—Apart from wounds and injuries, thrombosis of the arteries is most frequently caused by degeneration of the lining membrane, giving rise to rough surfaces to which the coagula attach themselves, and to aneurysms in which the coagulation is due to stagnation; aneurysmal thrombi are commonly laminated. Arrest of the circulation from any cause, as embolism, will also cause thrombosis.

Thrombosis of the larger arteries, without alteration of the lining membrane, is most probably always the result of embolism, the embolus being usually derived in the systemic arteries from thrombi of the heart, the result of asystole. Of this nature are the cases of thrombosis and gangrene of the extremities which sometimes occur in fevers and wasting diseases. Thrombosis of the pulmonary artery may be produced in a similar manner, or the embolus may be derived from a thrombus in the veins.

3. *Cardiac.*—Thrombosis of the heart may be caused by endocarditis, the thrombi then usually forming caps to the inflammatory outgrowths or vegetations. Large thrombi are most commonly caused by imperfect emptying of the cavities and consequent stagnation, due either to stenosis of the orifices, or to want of tone in the muscular walls. Thrombi may also extend into the right auricle from the venæ cavæ.

4. *Capillary.*—Capillary thrombosis may be due to extension from the veins and arteries, or it may be primary. In the latter case the conditions which cause it are imperfectly known; aggregations of white blood-globules will often block the capillaries and small vessels in the manner of thrombi, but this condition is usually transient, and not attended by true coagulation. The inhibitory influence of the lining membrane of the blood-vessels is so powerful in the capillaries that, as long as their structure remains intact, coagulation rarely takes place. Thus inflammatory stasis, or obstruction of the afferent artery by embolism, may exist for a considerable time without the blood in the capillaries coagulating.

5. *Lymphatic.*—Thrombosis of the lymphatics has been chiefly observed in the puerperal condition, in the lymphatics of the uterus and their continuations to the lumbar glands, and in rare instances in the thoracic duct. It is probably due to alteration in the constitution of the lymph, normal lymph having very slightly coagulable properties.

Symptoms.—The symptoms of thrombosis are those of arrest of the circulation, and they differ according to the vessel affected. In the veins, if a main trunk be obstructed, so that a sufficient collateral circulation cannot be rapidly established, the effects produced are passive hyperæmia, venous dilatation, transudation of serum, and sometimes hæmorrhage in the territory of the blocked vein, with enlargement of the collateral channels. In extreme cases moist gangrene may result. Thus, according to the vein affected, we may have anasarca of an extremity, ascites, or hydrothorax; hæmorrhage from the stomach, intestine, or kidney; œdema and cyanosis of the face and neck; and so on. The symptoms of arterial thrombosis are in the main those which are elsewhere described as occurring when the artery is blocked by embolism (*see* Embolism). Coagulation of blood in the cavities of the heart is described in a separate article. *See* Heart, Thrombosis of.

Treatment.—The treatment of thrombosis varies according to the seat of the process. *See* Aorta, Diseases of; Brain, Vessels of, Diseases of; Heart, Thrombosis of; and Veins, Diseases of.

W. Cayley.

THRUSH.—A parasitic stomatitis. *See* Mouth, Diseases of.

THYMUS GLAND, Diseases of.—Synon.: Fr. *Maladies du Thymus*; Ger. *Krankheiten der Thymusdrüse.*

In consequence of the atrophy of this organ in early life, little notice has been taken of it, either in its healthy state or when affected by disease.

According to the researches of Sir John Simon, the thymus gland reaches maturity in the child at the age of two years; it remains more or less perfect up to eight to twelve years; then it rapidly decreases in size, the glandular substance becoming converted into fat; and at the age of twenty years there is no trace of the organ left. At birth its weight is in proportion to the weight of the child. Taking 22 grs. to the lb. to be the usual proportion, 100 to 200 grains will be the weight of the gland at birth. From investigations made on young and hybernating animals, it appears that the greater the ratio of respiratory and muscular activity, the speedier is the decline of the gland. Consequently Sir John Simon thinks 'the thymus fulfils its use as a sinking fund of movement in the service of respiration.'

SUMMARY OF DISEASES.—Instances both of excessive growth and of prolonged existence of the thymus have been reported. A list of such cases was published by the late Mr. Alexander Bruce. In a healthy boy, aged fourteen, killed by an accident, the gland was found to weigh 620 grains; in a lunatic, aged twenty-one years, 300 grains; in a woman, aged twenty-nine years, 57 grains; in another woman, aged forty years, 30 grains. Krause mentions three cases, aged twenty-five, twenty-five, and twenty years, wherein the glands weighed respectively 292, 380, and 356 grains.

The actual diseases of the thymus gland which have been recorded are: (1) Inflammation, followed by suppuration. In one such instance the abscess burst into the trachea. Syphilis has been stated to be a cause of inflammation of the embryonic gland. (2) Fatty degeneration of the gland. (3) Tubercular deposit in the gland. (4) Malignant disease. (5) Enlargement of the gland in leucocythæmia; and in (6) lymphadenoma. (7) Calculi have been found embedded in the gland-substance.

Cases have been reported of children dying from suffocation, with no other cause assigned for their death than pressure on the trachea of an enlarged thymus gland. Considering its position, between the sternum and the windpipe, and the small power of resistance possessed by the rings of the trachea during infantile life, an enlarged thymus may be a possible cause of suffocation.

In connexion with enlargement of the gland, a respiratory affection called 'thymic asthma' has been recognised. It is also named after two physicians, 'Kopp's,' or 'Millar's' asthma; but the majority of writers on diseases of children deny the existence of such a malady.

PUGIN THORNTON.

THYROID GLAND, Diseases of.—

SYNON.: Fr. *Maladies de la Glande Thyréoïde*; Ger. *Krankheiten der Schilddrüse.*

Goître is the most common affection of the thyroid; and associated with it, but as a less prevalent disease, is exophthalmic goître. *See* GOÎTRE; and EXOPHTHALMIC GOÎTRE.

The causes of goître, such as iron in the drinking-water, the practice of carrying weights upon the head, the habitual exertion of mountain exercise, all point to the fact that the thyroid gland is closely connected with the circulatory system.

The diseases of the thyroid gland other than goître are rare. They comprise: (1) Acute Inflammation; (2) Hydatid Cysts; (3) Calcareous Deposit in the Gland; (4) Cancer; (5) Sarcoma; (6) Recurrent Thyroid Tumour. Fatty degeneration of the thyroid is of doubtful occurrence. Enlargement of the gland occasionally occurs in leucocythæmia, and in lymphadenoma. The gland is sometimes absent, or an accessory lobe may be present. It may degenerate in old people. The morbid states of the thyroid gland in cretinism and myxœdema are separately described (*see* CRETINISM; and MYXŒDEMA). The following affections alone require brief notice.

1. Acute Inflammation. — SYNON.. Thyroiditis.—This disease occurs in three forms: (*a*) *idiopathic*; (*b*) *metastatic*; and (*c*) *traumatic.*

(*a*) *Idiopathic* thyroiditis is the rarest of these forms of inflammation. It chiefly attacks young people, and is generally due to sudden changes of temperature.

(*b*) *Metastatic* thyroiditis is rarely observed as a complication of acute infectious diseases, especially typhus, puerperal fever, and pyæmia. It has also been met with in pneumonia and bronchitis; and in connexion with orchitis.

(*c*) *Traumatic* thyroiditis usually results in suppuration. Sphacelus of the gland is a possible result of active suppuration—a result not necessarily followed by any further mischief.

SYMPTOMS.—All three forms of thyroiditis commonly produce, amongst other symptoms which do not call for special description here, dyspnœa and dysphagia.

TREATMENT.—The treatment of inflammation of the thyroid gland consists in applying leeches and ice, and in using other antiphlogistic remedies. Deep-seated suppuration should be relieved by an early incision, otherwise the pus may find its way into the trachea or beneath the fascia. The best plan for opening the abscess is by means of the trocar and cannula.

2. Hydatid Cysts.—Echinococci have, in a few cases, produced an enlargement of the thyroid gland. These hydatid cysts are difficult to diagnose from goitrous cysts until the fluid contents have been examined microscopically.

3. **Calculi.** — These bodies have been found embedded in the substance of the thyroid. The writer has met with a specimen in which the calculus was the size of a walnut, and almost entirely took the place of the gland-substance of one lobe.

4. **Cancer.**—Primary cancer of the gland is a rare disease. It is met with in two forms—encephaloid and scirrhus. Cancer is not, it would appear, so commonly developed in a healthy gland as in one already affected by goitrous degeneration. Secondary cancer of the thyroid may also occur.

SYMPTOMS AND DIAGNOSIS. — The special symptoms caused by malignant disease of the thyroid are dyspnœa and dysphagia. The trachea and œsophagus may be involved in the disease. Very commonly one or both recurrent laryngeal nerves are included in an extension of the growth, and sometimes also the large vessels and nerves of the neck. Cancerous disease of the thyroid is probably present when there is a rapid enlargement of the gland, followed in an early stage by duskiness of the skin over the most prominent parts of the swelling. Superficial ulceration at a later date, often accompanied by hæmorrhage, and the general condition of the patient, will render the diagnosis clearer.

TREATMENT. — The only available treatment is entire removal of the gland, and this, to be of service, must be carried out at an early stage of the disease.

5. **Sarcoma.**—Sarcoma may be developed in the substance of a healthy thyroid gland, or in one already affected by goitrous disease. Thyroid sarcoma is, according to Lücke of Strasburg, rapid in its growth, not exceeding a year in duration. It requires removal of the entire gland.

6. **Recurrent Thyroid Tumour.**—An exceedingly interesting class of cases has been recognised within the last few years, in which tumours, growing simultaneously in various bones, such as the skull, vertebræ, and femur, and in the lungs and glands, have appeared, on examination, to be secondary to a simple adenomatous enlargement of the thyroid gland, and have presented microscopic characters precisely similar to that disease. *See* TUMOURS.

Therapeutic Action and Uses of Thyroid Gland.—The thyroid gland is now employed as a valuable therapeutic agent, especially in the treatment of cretinism, myxœdema, and skin-disease. *See* MYXŒDEMA.

PUGIN THORNTON.

TIC-DOULOUREUX

(Fr.)—SYNON.: Facial Neuralgia; Prosopalgia.

DEFINITION.—Neuralgia of the trigeminal, trifacial, or fifth nerve.

One alone, more often two, but rarely all three divisions of the fifth nerve of one side may be coincidently the seat of neuralgia. It is less common for the third division to suffer than the first and second. Tic has often been preceded or followed by neuralgia in other districts, especially in the occipital nerve.

ÆTIOLOGY.—Trigeminal neuralgia is rare in young children, but may occasionally occur in them, associated with delayed or irregular eruption of the permanent teeth. In these circumstances, it is sometimes accompanied by epileptic convulsions. In its megrim shape, it almost always attacks the sufferer at some time during the period of bodily development. According to the late Dr. Anstie, the middle period of life is not fruitful in *first attacks* of trigeminal neuralgia, but, given a declared neuralgic tendency, the wear and tear of this stage tend much to recall it. In women utero-gestation, the exhaustion from hæmorrhage at parturition, menorrhagia, or over-suckling, as well as the sexual changes in middle life, are especially prone to reproduce facial neuralgia. It is, however, in the period of degeneration that the worst and most intractable instances occur.

The term 'brow ague' is still frequently applied to a neuralgia of the first division of the trigeminal, which cannot always be referred to a malarious origin. Formerly, when malarious fevers were rife in this country, such an affection was, doubtless, of common occurrence; but at the present day, owing to drainage and cultivation, it is rare for this cause to be in operation. Cases do, however, occur, and these may usually be recognised by regular periodicity in the attacks of pain, a semi-algide condition of the system, and the rapid and effectual influence of quinine. Cold wind, especially with a moist atmosphere, has an undoubted influence in starting neuralgia of the fifth nerve, the unprotected condition of the face explaining probably its peculiar liability to be so attacked. There appears reason to think, however, that when damp with cold excites an attack of neuralgia, there must be at the same time a peculiar condition of the system, or neuralgia of the fifth would be much more common in this climate than it is. Such a condition is probably of a rheumatic or gouty nature, and the cold seems to start a subacute inflammation in the sheath of the nerve. As regards other general conditions predisposing to the affection, they are those common to neuralgia. *See* NEURALGIA.

Injury of the nerve; foreign bodies, irritating either this or some other nerve; morbid growths of bone, especially such as cause contraction of bony canals traversed by branches of the nerve; and syphilitic periostitis, may act as exciting causes of tic-douloureux. Or the immediate cause may be in the floor of the cranium, in the form of tumours or disease of bone or of membranes, aneurysm, or abscess.

Symptoms.—Some obscure feeling of discomfort may precede the outburst of actual pain, or this may occur suddenly and without warning in some part of the district supplied by the fifth nerve. There will be one or more foci from which the pain will seem to emanate in swift flashes, a dull aching remaining in the intervals, of a very wearying character. Generally short-lived at first, the paroxysms of darting, burning, boring pain gradually increase in severity and duration. The patient sometimes cringes under the violence of the agony. When fairly pronounced, there is a great tendency to the excitement of a paroxysm by the influence of such slight irritants as a current of air, a sudden noise, or the muscular movements concerned in speaking, laughing, chewing, blowing the nose, or coughing. The attack of tic may vary to any extent in degree and duration, from a short-lived paroxysm which never returns, to a disease of the most obstinate character, embittering, with more or less constantly repeated attacks, the whole of a long life. In such cases it has a tendency to remit during the course of severe intercurrent diseases.

When the *ophthalmic division* of the nerve is affected, it sometimes happens that the first notice of the attack is an exceeding soreness of some spot on the scalp, recognised only on brushing the hair, and this is followed some hours afterwards by pains in the branch of nerve distributed to this point. The pains are most marked, and tenderness on pressure can generally be noted, in one or more of the following places: the supra-orbital notch, at a point a little above the parietal eminence, in the upper eyelid, at the junction of the nasal bone with its cartilage, within the eyeball, or at the inner angle of the orbit. There is often lacrymation, with redness of the conjunctiva, and sometimes intolerance of light. There is sometimes so much tenderness that the patient cannot wear a hat, or even wash his forehead. Or he may be unable to blow his nose. If one or two hairs be drawn over this hyperæsthetic surface, it will be found that the tactile discrimination is diminished, as compared with the corresponding region of the opposite side. The pain is sometimes described as shooting in the upper eyelid, or going between the eyeball and the cavity of the orbit, extending thence over the brow, as though the forehead were being slit open. Pressure upon the parietal eminence will send a sort of heavy dull shock into the eye. To neuralgia of this division, in consequence of the pain being limited to one-half of the anterior aspect of the head, the term *hemicrania* has been applied, whence the *migraine* of the French, and the vernacular 'megrim.' The neuralgic affection constitutes, however, only a portion of the complex group of phenomena to which the term 'migraine' is properly applicable, and which may include, besides, subjective sensations of dazzling lights or colours, often of a zigzag shape, transient hemiopia, vertigo, unilateral numbness and tingling of extremities, impairment of speech, nausea, and vomiting. *See* Megrim.

When the *superior maxillary division* is in fault, violent pain is experienced in the cheek-bone or jaw, or in both, points of tenderness being found at the site of emergence of the infra-orbital nerve, over the malar bone, or on the gum of the upper jaw. The attacks of pain are sometimes accompanied by profuse watery secretion from the nasal and buccal mucous membranes. There may be swelling and acute sensitiveness of the lip and nostril, the slightest contact with which causes pain to shoot widely in various directions, sometimes appearing to affect distant parts of the body. Acute pain may also occur in the parotid gland, accompanied by a great flow of saliva; and also in the teeth.

When the *third division* is attacked, points of intensity may be found on the temple, a little in front of the ear, at the place of exit of the inferior dental nerve, at the side of the tip of the tongue, or more rarely in the lower lip. The writer has met with cases in which neuralgia of this division, attacking both sides of the lower jaw and the under-surface of both borders of the tongue, occurred in plunges of agony which caused the patient to utter a kind of shrieking groan, and the head was jerked convulsively. Such attacks may be brought on by chewing, swallowing, and even by speaking. In other cases the pain may be entirely localised in one side of the tongue-tip, but here at times it is so intense that the patient rolls on the floor in agony. To cases of this kind, marked by lightning-like seizures of exquisite character, and accompanied by spasmodic movements of the facial muscles, the term *epileptiform neuralgia* is sometimes applied. Hereditary tendency to insanity sometimes accompanies this form. The lingual branch of the fifth is happily not so often affected as the other portions, for there is probably no form of neuralgia involving more exquisite suffering. When the auriculo-temporal division is affected, pain is situated in the outer auditory meatus and temple. Many cases of so-called earache are doubtless examples of neuralgia affecting this nerve.

There is a variety of trigeminal neuralgia which is known as *clavus hystericus*, and which occurs chiefly, but by no means solely, in females, and affects the period of bodily development. It is characterised by intense pain, limited to one or two small points (the parietal, or supra-orbital), and resembling the driving of a nail into the skull. It occurs most often in the anæmic, and has frequently been mistaken, with unfortunate results, for some inflammatory affection demanding depletory measures.

In severe tic-douloureux the facial muscles, those of the tongue, and even sometimes those rotating the head, may be spasmodically contracted by reflex action (*see* FIFTH NERVE, Diseases of). With supra-orbital neuralgia there may be blepharospasm or strabismus. The writer once saw a patient liable to neuralgia of the supra-orbital division for a period of twenty years, in whom, one year before, the attack began to be attended with complete ptosis and external strabismus, from paralysis of the third nerve. A certain amount of weakness continued between the attacks, but it was as an immediate sequel of the pain that the loss of power was most strongly marked. Two days after the cessation of the pain the eyelid could be raised fairly well and the eyeball moved, though never quite freely. Some degree of vaso-motor paralysis was shown by the reddening and heightened temperature of the face and swelling of the veins, which occurred unilaterally during the paroxysms of pain, as well as by the soreness of skin, indicating probably a temporary congestion which remained behind. To the same cause must be referred the extreme redness of the conjunctivæ and mucous membrane of the nostrils, with increased lacrymation and flow of nasal and buccal secretion, often observed in this form of neuralgia. The hair is very liable to be changed in colour about the seat of pain. There may be a permanent blanching, as of the greater part of an eyebrow or a small tuft upon the head, or the change may be a fluctuating one, the colour returning during the intermissions of the disease. Individual hairs in the district of the affected nerve may be hypertrophied, or the converse may happen; and during the persistence of attacks the hair may become brittle and fall out, to return, however, when the neuralgia subsides. The late Dr. Anstie described a state of thickening, the result of subacute inflammation, in the periosteum of bone and in fibrous fasciæ in the neighbourhood of the painful points of neuralgic nerves. Pressure on these swellings may not merely excite pains in the affected branches, but send a powerful reflex influence through the cord to distant organs, causing vomiting, or affecting the action of the heart. The skin is apt to grow coarse; and patches of pigment to occur in the painful situations. In neuralgia of the second and third divisions the corresponding half of the tongue is sometimes seen to be covered with fur from overgrowth of epithelium, and this even when the process of mastication has taken place equally on each side; or there may be salivation severe enough to cause a suspicion of mercurial action, but which may be distinguished by its being unilateral. Acute inflammation of the skin, in the form of herpes or of erysipelas, not infrequently attends neuralgia of the fifth, especially its first division; and the eyeball itself may become in similar circumstances the seat of serious inflammatory action in one or other of its tissues. There may be a profuse and extensive eruption of herpes, leaving cicatrices which suggest confluent small-pox. In such a case neuralgic pains may cease during the eruption, to recur with great violence whilst this is scabbing. Acute glaucoma is attended by symptoms which appear to refer it to trophic changes consequent on neuralgia of the ophthalmic division of the fifth. There appears reason to think that recurrent iritis may sometimes be related to neuralgia or some kindred affection of the same division. Common sensation is frequently blunted during and after paroxysms of tic; but occasionally there will be so much and such persistent hyperæsthesia of the skin, that the patient cannot bear the face to be washed. In epileptiform tic the sufferer will often be observed to rub violently with a handkerchief the part of the face affected; but, on the other hand, there are cases in which not even the touch of a light bonnet can be borne, so exquisitely sensitive is a portion of the scalp. A touch with the finger upon this locality will sometimes cause the patient to fall to the ground.

DIAGNOSIS.—The paroxysmal character of the pains, coupled with the tenderness on pressing various points, sufficiently indicates tic-douloureux. The only condition with which it is at all easily confounded is the painful anæsthesia which is apt to be an early symptom of the encroachment of a tumour upon, or some other destructive lesion of the trunk of the nerve within the cranium (*see* FIFTH NERVE, Diseases of). The presence of the pain will distinguish the spasmodic contractions of the facial muscles secondary to neuralgia from mimetic spasm proper. There is no doubt that neuralgia about the forehead is often mistaken for some inflammatory intracranial mischief, and this is peculiarly liable to happen where either ptosis or strabismus forms part of the symptoms. Careful examination, bearing in mind the points of diagnosis described, ought to obviate error. Still more important is it to avoid the error of ascribing to this form of neuralgia the pain occasioned by the growth of intracranial tumour (*see* BRAIN, Tumours and New-Growths of). It must be remembered that pus in the antrum may occasion neuralgic symptoms; and that a fruitful source of trigeminal neuralgia is caries of the teeth.

DURATION AND PROGNOSIS.—Tic-douloureux occurring in youth and apparently as an accident of exposure, or as a result of faulty teeth, may never recur. It is perhaps more common, however, for repetitions of the attack to take place, alternating, it may be, with neuralgia in other quarters. Tic is not infrequently liable to recur, especially under circumstances of depression, through a whole lifetime, but it may never have the character of extreme severity. In certain few cases, however, it is not only obstinate, but of terrible violence, the patient being incapacitated through many years by the constantly recurring affection. The pain has been in some cases violent enough to destroy life. As a rule, however, the disease, however severe the agony entailed by it, does not seem of itself to shorten the duration of the life which it fills with suffering.

Treatment.—As in neuralgia generally, the treatment of tic is partly constitutional, and partly local and palliative of suffering (*see* Neuralgia). The first care in a case should be to have the state of the teeth accurately investigated, and faulty teeth removed or otherwise treated. It may happen that a tooth betraying no outward signs of decay is carious internally, and may thus easily escape recognition.

The hypodermic injection of morphine holds the first place as a means of relief. It is well to begin with a small dose, say $\frac{1}{10}$th grain, and repeat it in the course of twelve hours if necessary. If the doses employed can be kept at a moderate amount, there will not be much fear of opium-hunger being created, and they can be discontinued without difficulty as the disorder subsides. The injection is quite as efficacious when made in the arm as in the face. Blisters are often of great service. A small one should be applied over the branches of the cervico-occipital nerve at the nape of the neck, and repeated if necessary. The constant voltaic current is sometimes useful. A sufficient number of cells (from four to eight or ten) should be employed to give such a current as causes the negative pole to impart a very distinct burning sensation. The circuit should never be abruptly opened by the removal of the rheophore; a gradual heightening and lowering of the strength, respectively, should take place, both on applying and when leaving off, to avoid a shock. The rheophores should be fitted with sponges well moistened with salt and water, or with carbons plunged for a minute or two in hot water. The application may be continued for five or ten minutes at a time, and be repeated several times daily. In some cases of tic a combination of 20 or 30 grains of chloride of ammonium with 5 drops of liquid extract of opium, taken two or three times a day, is singularly efficacious.

Butyl chloral hydrate—2 to 4 grains in a pill taken every two hours for a few times—may be sometimes employed with advantage. So, also, the tincture of gelsemium sempervirens, given in doses of 15 to 20 minims every two hours, till relief is obtained. Phenazone, in doses from 5 grains every half-hour, or from 10 to 20 grains every four or five hours, for a few times, is sometimes particularly useful. The hydrate of chloral in a dose of 20 grains will occasionally be of great service, if the pain is not very severe, in procuring a natural kind of sleep from which the patient wakes relieved. If, however, the pain be severe, chloral hydrate is useless. It is important not to confound the epithelial overgrowth of the tongue, which so commonly occurs in tic, with the ordinary furring from digestive difficulties which is supposed to indicate a necessity for purgatives. It will be observed that it only affects a lateral half.

In two cases of epileptiform tic of from seven to ten years' duration, which had resisted all treatment, and incapacitated the sufferers from earning their livelihood, the writer had two out of the three divisions of the trigeminal stretched, with most satisfactory results. In one case five months, in the other about twelve months, have elapsed since the operation, without return of pain. It appears to be essential that not only the central end of the nerve should be pulled upon with considerable force, but also the peripheral portion. A considerable amount of cutaneous anæsthesia ought to follow the operation, though it usually does not last more than a few days. In cases of still more obstinate tic-douloureux, operations have been performed on the nerve and its ganglion at the base of the skull. *See* Nerves, Diseases of.

T. Buzzard.

TIN, Poisoning by.

— Synon.: Fr. *Empoisonnement par l'Étain*; Ger. *Zinnvergiftung*.

The importance of tin as a toxic agent has only comparatively recently been recognised; for although attention was drawn nearly a century ago to the possible danger attending the use of tinned vessels for culinary purposes, the danger was supposed to be due simply to the contamination of the metal with arsenic. Subsequently alarm was excited in consequence of the employment of alloys of tin for the storage of tinned preserved articles of food, such as meat, vegetables, and fruits; but here again the danger has been assigned to the lead with which the tin is alloyed, a lead-tin alloy being used for the construction of the capsules employed. Recently, attention has been directed to the tin with which tinned foods and fruits are almost invariably contaminated, as itself presenting a source of danger to the consumer. It is known that the soluble salts of tin, met with in commerce as *Dyer's salt*, *pink salt*, &c., are poisonous; and experiments on animals show that even the insoluble hydrated oxides of tin are fatally poisonous, the oxides being no doubt dissolved in the alimentary fluids, tin having been detected after death in such cases in the liver and other solid viscera. Certain kinds of sugar recently brought into commerce are prepared by a process which introduces tin to the extent of from one-fourth to one-third of a grain per lb. of sugar into the manufactured article; and it is at present a moot point whether these sugars are innocuous or deleterious.

Anatomical Characters. — The *post-mortem* appearances in fatal poisoning by tin are those of the mineral irritants. The cases observed have been too rare to be spoken of otherwise than generally. *See* Poisons.

Symptoms.—Of these but little is known. Concentrated solutions of stannous chloride and of stannic chloride—the lower and higher chlorides respectively of the metal—are known to act as irritant poisons. Neurotic symptoms are also manifested, so that tin-salts do not appear to act simply as irritants. In large doses the chlorides produce fatal results. Probably the toxic results are heightened by the free hydrochloric acid invariably present in the commercial solutions of stannous and stannic chlorides.

Treatment.—The treatment to be employed is that for mineral acids. *See* Poisons.

Thomas Stevenson.

TINEA (*tinea*, a moth-worm). — *See* Epiphytic Skin-Diseases; Tinea Imbricata; Tinea Trichophytina; and Tinea Versicolor.

TINEA IMBRICATA.—Synon.: Solomon Island or Tokelau Ringworm; *Herpes Desquamans* (Turner).

Definition. — An epiphytic skin-disease, produced by a fungus resembling the trichophyton, and characterised by an imbricated, scaly desquamation.

Geographical Distribution.—As far as is known, this disease is at present confined to the islands and countries included in the area within 175° W. and 95° E. longitude, and the north and south tropics; but, as it spreads with great rapidity when introduced into districts with a favourable climate (Turner, *Samoa Med. Mis. Reports*), it is not improbable that, as communication extends, it will in time become endemic in all tropical countries possessing a damp atmosphere and a temperature ranging between 70° and 90° F. In certain places within the endemic area it is exceedingly prevalent; Florida Islands, for example, where one-half, and the Treasury Islands, where four-fifths, of the inhabitants are affected (Guppy). Throughout the Malay country it is common, and cases have frequently been noted on the China seaboard as far north as Foochow. It attacks foreigners as well as natives.

Symptoms.—Usually the disease occupies a large area. In old-standing cases the entire integument, with the exception, perhaps, of the palms of the hands and the soles of the feet and part of the hairy scalp, is covered with the characteristic thin, tissue-paper-like scales arranged in concentric parallel lines. These scales vary in size, according to their situation and the amount of friction they have been subjected to, from one-sixteenth to half an inch in breadth, by a quarter of an inch to one inch or more in length. They are firmly attached to and continuous with the healthy epidermis at the periphery or advancing edge of the circle they belong to, and free and ragged at the other edge. At, and just beyond the line of their attachment the skin is darkened from aggregation of the fungus, which, in its advance, is raising and throwing off the epidermis. The parallel lines of scales may be from an eighth to half an inch apart.

The pattern, so to speak, of the disease is readily understood from an inoculation experiment. By rubbing scales from a case into abraded healthy skin the fungus is easily implanted. In about ten days thereafter it has so multiplied that it forms a brown layer underneath the epidermis. As this layer extends, the epidermis over its centre breaks down, and a scaly ring is formed. Gradually the ring so formed enlarges, and a second brown spot forms in the common centre. This, in its turn, extends, its centre also breaking down. Then a third ring forms in the same way, and a fourth, and so on in never-ending series—like the waves made by a stone thrown into a pond.

Where two or more rings impinge, a gyrated or scalloped pattern is produced.

Itching is sometimes complained of, but there is never any sign of inflammation of the skin, as in common ringworm.

The fungus is readily demonstrated by placing a scale moistened with liquor potassæ under the microscope. It closely resembles the trichophyton, but may be distinguished from it by its prodigious profusion, its position just under the epidermis, and, perhaps, by the presence in the interior of the conidia and mycelium of many brown particles. Unlike trichophyton, it has no special predilection for the hair or hair-follicles; in fact, it seems to thrive best on the non-hairy parts of the body.

Diagnosis. — Tinea imbricata is distinguishable from ordinary ringworm by the size of the scales, by the numerous, closely approximated, concentric parallel rings, by the absence of inflammatory redness, and by the extreme profusion of the fungus. From psoriasis and ichthyosis it is diagnosed by the presence of the fungus, the concentric rings, and by the attachment of the scales being at one edge only.

Treatment.—Painting the affected parts —taking a limb or part of the body at a time—with iodine liniment is at once effective. All clothes must be boiled or destroyed; and relapses at once treated. In the labour-ships of the South Pacific sulphur ointment inunction is the treatment adopted, and with success. Patrick Manson.

TINEA TRICHOPHYTINA. — SYNON.: Common Ringworm; *Tinea Tonsurans*; Fr. *Trichophytie* (Hardy); Ger. *Scheerende Flechte.*

DEFINITION.—A contagious disease of the skin of man and some animals; caused by the growth in the skin of the trichophyton fungus (Gruby and Malmsten, 1842–5); and characterised for the most part by inflammation of the skin, and disintegration of the hairs.

ÆTIOLOGY. — The trichophyton fungus grows in the horny epidermis of man, cattle, the dog, cat, horse, guinea-pig, and rabbit; and we know nothing of its existence elsewhere. The affection is intercommunicable between these animals, and frequently inoculated from them to man. Ringworm is, however, mostly passed by simple contact from person to person, or through the medium of hairdressers, or brushes, towels, caps, and so on. Isolated cases occur; or it is endemic—on the body in hot climates, and on the head in England, France, Italy, and other countries; occasionally it is epidemic in a community. We know little about the soil preferred by the fungus; like favus, it particularly affects the young. A comparatively high temperature with moisture favours it; hence its frequency and severity in the tropics, and in the rainy and hot seasons. Some think it especially attacks the delicate, but the explanation probably is that it grows in the finer skins and hairs with more ease.

The *fungus* attacks the hairs with more avidity than does the achorion, and is more easily inoculated. The mycelium (·0018 to ·0026 mm. in diameter) consists of very long, fairly straight and regular threads, but little ramified, and in these respects is distinguishable from the achorion. The rounded, uncoloured, strongly refractile spores vary from ·0021 to ·0035 mm. in diameter, and are more uniform in size and shape than achorion. They may be seen isolated or in moniliform chains, joined to the mycelium or massed together. The spores become more numerous as time goes on, and are especially abundant in the structures of the hair and nail. The fungus is distinguishable in cultures. *See* EPIPHYTIC SKIN-DISEASES.

After an extended series of researches by means of the microscope, cultivations, and inoculations, Sabouraud has distinguished at least three species of trichophyton affecting man. These he identifies with those described by Gruby in 1842–44. They are probably often saprophytic, and this is especially likely to be the case with the first to be mentioned. *See* MICRO-ORGANISMS.

1. *Trichophyton megalosporon ectothrix.* This trichophyton is characterised by *large* spores and mycelium, situated between the hair and its follicular sheath, and always derivable from animals, especially the horse. The so-called kerion, *T. barbæ*, and the rarer *Perifolliculitis agminata* are caused by it.

2. *Trichophyton megalosporon endothrix.* This trichophyton is also characterised by *large* spores (7–8μ diameter), which invade the hair-structure itself. It is the cause of *T. circinata*, and of about 35 per cent. of the cases of *T. tonsurans.*

3. *Trichophyton microsporon Audouini.* A trichophyton characterised by small spores (2–3μ diameter), and without appreciable mycelium was originally named by Gruby in honour of a distinguished investigator of the muscardine of silkworms. Gruby described this species as occurring in a variety of ringworm-patch which he called *Porrigo decalvans*, the name applied by Thomas Bateman to what is now known as *Alopecia areata.* This unfortunate error has given rise to endless confusion. This small-spored form permeates the hair and forms a sheath around it, and has a special preference for the scalp of children. Most of the rebellious cases are due to this cause.

DESCRIPTION.—The objective symptoms of tinea vary widely, according to the site attacked, especially with reference to the hairiness of the region, the suitability of the nutrient medium, the conditions of heat and moisture, the state of nutrition of the tissues, and their susceptibility to respond to the varying degrees of irritation provoked by different specimens of the fungus. Thus four phases of disease may be usefully distinguished, namely, (1) *Tinea trichophytina tonsurans*, or the tonsure-making ringworm of the scalp; (2) *T. t. circinata*, or ringworm of comparatively glabrous parts; (3) *T. t. barbæ*, or *T. sycosis*, affecting the hairy portion of the face and neck; and (4) *T. t. unguium*, or ringworm of the nails. These phases frequently co-exist.

1. *Tinea t. tonsurans.*—Ringworm of the scalp is excessively frequent in this country, especially in London. It is a standing nuisance in our elementary and some other schools, and not infrequently leads to a child's temporary exclusion, and may interfere seriously with his life prospect. It may spread unnoticed for weeks and even months. The typical patch is seen as a rounded desquamating area, in size from a threepenny-piece to a four-shilling piece, over which the hairs, issuing from erected follicles, lie in a disorderly manner, and are reduced to lustreless, opaque, brittle, swollen, and distorted stumps, and look as if they had been nibbled off. Under the microscope mycelium will be found amongst the scales, and in and around the hairs some mycelium and quantities of spores. The fungus enters the follicle and proliferates there freely, passing into the hair, and spreading almost to the bulb and sometimes a long way up the shaft. In this way, the cuticle and the fibres of the hair are completely disintegrated. If the hair is less

diseased, it can be extracted with its root-sheath. When the disease has lasted some time, cutting the hair will reveal patches in all stages. Some are just beginning as small rounded scaly spots, over which the hair is not yet altered; others, of larger size, have a few hairs affected; and so on. Thus, as the satellites grow which arise around the larger patches, and are absorbed to form gyrate or irregular areas, and as fresh spots are inoculated, the greater portion of the scalp may be eventually involved. T. circinata, of adjoining portions of the face, neck, and shoulders, is frequently associated. The scurf consists of epithelium and sebum, the product of inflammation involving the skin-surface as well as the follicles; but redness of the surface is not often seen in the scalp, nor a margined circle as on the body.

Endless variations of this typical condition are met with. Firstly, the crusting of sebum may be very free, and encase each hair in an asbestos-like sheath, and cake all together in a crusted mass. Various degrees of this seborrhœa may exist. Secondly, the case may be complicated by eczema, and the crusts hide the characteristic stumps. Thirdly, the degree of inflammation induced may be severe, so that no typical areas are seen; but directly a follicle is involved a solid lump, perhaps the size of a pea, is formed, which may suppurate. Occasionally a large area is thus involved; and as an abscess is simulated, it is cut into, but no pus found. A variety of this phase, where the patulous mouths of follicles exude a viscous fluid, is called *kerion*; but this term is often applied loosely to any ringworm which is much inflamed.

Ringworm of the scalp is very chronic. It affects both sexes, and especially the young; infrequently tender infants; rarely adults.

2. *Tinea t. circinata.*—Ringworm of glabrous parts has usually two characteristics. The fungus grows out equally in all directions, so that the patches tend to be circinate (hence the name) and marginate like the 'fairy rings' of downs, but are sometimes atypical and irregular in shape. Secondly, an inflammatory eruption is caused; and the inflammation may be of all degrees. It is commonly erythematous, but may be papular, vesicular (hence the old term Herpes circinatus) or pustular, or, rarely, bullous. Usually these objective symptoms appear on the spreading border. Hence we get a tiny red scaly spot, enlarging peripherally by slow degrees, and often studded with papules, or perhaps crusted over, whilst the extending edge may be papular, vesicular or pustular, or simply uniformly raised. Sometimes two or more concentric rings develop. On so-called glabrous parts the diseased hairs are not nearly such a prominent feature as on the scalp; and the areas do not spread indefinitely, but often tend to die down spontaneously after a time, or only extend by coalescence. In hot countries, where ringworm of the general surface and beneath the loin-cloth is very common, and more rarely in temperate climates, the disease is most extensively developed in the hot and rainy seasons, and the body becomes more or less widely covered with figured coalescent patches. Curiously enough, ringworm of the scalp in these countries seems to be less frequent than with us. There is still another well-known and not uncommon phase to note. We occasionally observe isolated cases or small family epidemics, in which a margined ringworm forms on the inguino-cruro-scrotal or axillary regions, perhaps bilaterally. This was at one time thought to be an eczema and not parasitic, and is often still called *Eczema marginatum.*

3. *Tinea t. barbæ.*—Ringworm of the hairy parts of the face, or more especially the beard, is not at all uncommon in this country, and assumes such peculiar features that it must be specially described. It is a penalty paid for the luxury of being shaved. The early stages usually consist in the formation of the ordinary T. circinata patches, which presently become indistinct; and so great are the irritation and the infiltration produced in this region, that soon considerable nodules and even tumours are formed along the jaw. If these swellings are carefully examined, they will often be found studded with stumps of hairs characteristically diseased, but these hairs may fall out. At other times pustules form and simulate the pustular folliculitis known as sycosis. Indeed, this phase of ringworm is sometimes called *T. sycosis*, or *parasitic sycosis.*

4. *Tinea t. unguium.*—Ringworm of the nails, or Trichophytic onychomycosis, occasionally comes under notice, and the observer may never suspect the nature of the malady, especially when any pre-existent ringworm elsewhere has disappeared. It is naturally very chronic; and one or more or, rarely, all the nails of the hands and feet may be affected. The change in the nail commences by whitish points on the lateral parts, seen through the unaltered upper layers. Longitudinal striæ form; and the nail gradually becomes greatly thickened, brittle, exfoliating, discoloured, disorganised, and distorted.

DIAGNOSIS.—Typical patches of *ringworm of the scalp* are easily recognisable from simple seborrhœa, psoriasis, or other diseases, by the characters already given; but many atypical phases, and conditions altered by treatment and complications, such as seborrhœa, eczema, and impetigo, come before us. We have already referred to the occurrence of pustules, small phlegmons, and more considerable swellings, such as kerion. It is useless to rely on the observance of ringed patches, but it may be said that whenever desquamating patches occur on the heads of the young, the ringworm fungus should be carefully sought for. It is essential for a correct diagnosis that the observer should be thoroughly skilled in the detection of the characteristic hairs and fungus, for without this no amount of detailed description will save him from failure. As a case is getting well, only a few isolated stumps or withered brittle hairs may be scattered about the scalp. *Alopecia areata* is distinguished by the bald, smooth, wasted patches, quite free from signs of inflammation. Stumps occur round the margins of some cases of alopecia areata, but they are club-shaped or like 'notes of interrogation,' free from fungus, and not brittle and swollen. Ringworm patches, after long rubbing or under other conditions, occasionally, however, closely simulate alopecia areata.

Ringworm of glabrous regions makes its nature suspected by its centrifugal spread and margined border; but it is proper, and indeed sometimes necessary, to display the fungus to make a sure diagnosis. The fungus, however, may be difficult to find. This affection has to be distinguished from all other forms of ringed eruption—*e.g.* seborrhœa (eczema seborrhœicum), psoriasis, pityriasis rosea, vesicating erythema multiforme (herpes iris), and macular leprosy; also from circumscribed eczemas and intertrigo. Ringworm contracted from horses and cattle may set up severe inflammation. On the hands and feet the patches are often atypical.

Ringworm of the beard may generally be detected by the characteristic stumps and fungus. Careful search must be made in all cases of scaly patches, pustular folliculitis, and phlegmons occurring in this region.

Trichophytic onychomycosis is often very difficult to diagnose, and to separate by naked-eye appearances from other disintegrating and hypertrophic affections of the nails. The fungus must be sought for.

Treatment.—There is no method of dieting or internal medication which will so alter the soil as to perceptibly retard or prevent the growth of the fungus of tinea, or which directly kills the parasite. Obviously, however, it will be proper to try and restore defective nutrition, and correct any departure from the standard of health presented by the patient.

Prophylaxis is most necessary, and every child with ringworm should be excluded from school, and isolated as far as possible from other children, who should be carefully examined from time to time. Separate toilet requisites should be provided, and kept disinfected. Light paper, linen, or silk head coverings, which can be easily disinfected or destroyed, should be always worn, either as a separate article, or as a lining to the ordinary head gear. The source of contagion should be investigated.

The principles only which should govern the *local treatment* can be here discussed, as it would be quite impracticable to attempt to give in detail all the remedies and methods so strongly recommended from time to time. Laboratory experiments would lead us to suppose that nothing could be easier than to eradicate the fungus by the exclusion of oxygen, or application of some parasiticide or acid medium; but practically it is most difficult in those cases where the fungus has once established itself in the lower parts of the hair and its envelopes. This is chiefly due to the mechanical difficulty in getting the parasiticide in contact with the fungus, and partly to other obscure causes. We have then to recognise the fact that the mere application of parasiticides, however energetic, or acids (such as acetic acid) which are inimical to the growth of achorion and trichophyton, is only useful up to a certain point, and only masters the disease situated in deeper parts after a long time. We can do very much by removing the fungus mechanically, that is, by promoting free desquamation, and the removal of the diseased hairs.

Tinea t. tonsurans.—(1) In the first place it is advisable to cut the hair quite short, if possible over the whole head, or at any rate around the diseased areas, and, moreover, to keep it so. This displays the distribution of the disease, and promotes cleanliness and more efficient application of the remedies. Shaving the patches under antiseptic precautions every ten days or so is strongly to be recommended, as it removes a quantity of fungus above the surface of the skin. (2) All crusting should be cleared away. (3) The head should be systematically scrubbed each day with soft, tar, sulphur, carbolic, or other suitably medicated soap. This proceeding is cleanly, prevents the lodgment of fungus, and helps to clear out the mouths of the follicles. (4) There is an endless number of parasiticide applications to select from, such as the bichloride, biniodide, and oleate of mercury, citrine and other mercurial ointments; the acetate, sulphate, and oleate of copper; nitrate of silver; sulphur, iodide of sulphur, sulphurous acid, hyposulphite of sodium; iodine preparations; carbolic, salicylic, chrysophanic, and acetic acids; resorcin, naphthol, creasote, thymol, turpentine, oil of cade, and similar remedies. These can be used in various combinations and alternations, in the form of powder, liquid, ointment, plaster, and so on. To make them more penetrating, they may be conveyed to the part in fats, lanolin, glycerine, ether, or chloroform; or a variety of collodion varnishes may be used to exclude the air and prevent dissemination. The choice of the remedy, and the strength of the application, must depend on the object to be attained, the extent over which it is used, and other circumstances. If the parasiticide action alone is sought, the production of a weeping dermatitis is usually avoided, but the treatment under these conditions is a long one. We can greatly assist the cure by mechanical means, as by causing free desquamation, by blistering, by removing the epidermis and diseased hairs by the curette and thus exposing the gaping follicles, or by exciting a pustular or phlegmonous dermatitis over *small* areas. By mopping in a solution of iodine in creasote or like applications a crust is formed; and, when set, this is dragged off, bearing the entangled hairs. Phlegmonous inflammation is difficult to produce to order, but when brought about the hairs fall out with the happiest results. (5) Epilation of the hairs is of the greatest value, and is systematically carried out in France, not only over the diseased areas, but by forming a protective zone around. Some practice and skill are necessary. It seems useless to try and epilate much-diseased hairs, as they only break off, and the razor will do as well; but when the hairs become less brittle, or are loosened by surrounding inflammation, their extraction is much more satisfactory.

By the stereotyped forms of treatment, which consist in rubbing in parasiticides, the duration of the affair is always long—generally months, or even years if the disease is deep-seated and extensive.

T. t. barbæ or *T. sycosis* must be treated on the same principles. If the phlegmonous folliculitis is very severe, fomentations of boric acid or weak sublimate or hyposulphite of sodium will be necessary, as for kerion of the scalp.

T. t. corporis, when recent, can be easily cured by the application of tincture of iodine, or the persistent rubbing in of parasiticides in ointment, glycerole, or other preparation. Fresh undiluted sulphurous acid is a good remedy, and can usually be borne. Inveterate or widespread cases should be treated like psoriasis. Goa powder, moistened with acetic acid or lemon juice, is a favourite remedy in hot countries.

T. t. unguium requires that the nail should be softened in strong potash solution preparatory to scraping or cutting away. When sufficient is removed, parasiticides may be rubbed in, or the part kept soaked in them.

T. Colcott Fox.

TINEA VERSICOLOR. — Synon.: Willan, Fr., and Ger. *Pityriasis Versicolor*; *Phytosis Versicolor.*

Definition.—An affection of the epidermis, characterised by an extensive discoloration, sometimes fawn, sometimes olive. The irregularly shaped patches and blotches give the integument a variegated or mottled appearance.

Ætiology. — Tinea versicolor indicates lowered nutritive action of the skin, associated in many instances with general debility, but in others the health is unaffected. It is frequent in proportion to warmth of climate, and to warmth of each part of the individual's body. A mould, the *microsporon furfur*, discovered by Eichstedt, can be always found in the epidermis.

Description.—The most common site of tinea versicolor is the trunk, where it may assume a symmetrical distribution, spreading down the sides from the armpits, or occupying the middle line or even the whole surface of the abdomen. Thence it may descend to the thighs like an apron. It is likewise met with between the scapulæ, in the mammary furrow of women, on the neck, upper arms, and flexures of the elbows. The uncovered and habitually washed parts of the skin are exempt, as light and air and cleanliness check the growth of the epiphyte. *See* Epiphytic Skin-Diseases.

If closely examined, the discoloured skin appears punctated by the follicles, which are deeper tinted than the rest of the surface. This inspection satisfies us that the perspiratory ducts mainly harbour the cryptogam, while the hair-follicles are not invaded. The patches are slightly elevated, and they present evidence of some hyperæmia; further, we discover that by the nail the coloured epidermis can be readily crumbled and separated, and that it also takes on a branny exfoliation—hence the synonym of *pityriasis.* The distinctive characters, therefore, are the colour, which is fawn in blondes, brown in brunettes; the patchy distribution; the exfoliation; and the itchiness, especially marked when exercise heats the body. Such features, however, vary considerably in degree; in some instances the colour is so pronounced as to suggest a pigmentary affection simply; in others, the exfoliation is remarkable; while, again, the itching may be either almost absent or insufferable. In the coloured races the patches are grey.

The malady is mainly inconvenient from its appearance; but as the sites are rarely exposed, it is often borne for years without the person seeking advice. Disease of the liver is now and then dreaded by the patients, owing to their yellow hue. It is discovered very often in the phthisical and others who sweat profusely, especially if they wear flannels without frequent change.

Contagiousness is not strong, as the affection may exist for years upon a husband or a wife without spreading to the other; it seems that a special soil is more distinctly needed than in the case of any other of the dermatological flora. It is a disease of the adult, unlike the other tineæ, which are, moreover, unattended by pigmentation. It rarely gets well without persevering treatment, and is very apt to relapse.

Diagnosis.—A thin fragment of the exfoliated epidermis, treated with a solution of caustic potash, exhibits under the microscope with a quarter-inch object-glass, numerous clusters of cells about the size of red blood-corpuscles; these are the conidia of the well-defined *microsporon furfur.* Threads, the mycelia, interlace between the cells. The diseases with which this well-defined malady has been confounded are the abnormal pigmentations, melasma and chloasma, macular syphilide, and pityriasis. The slight elevation, peculiar exfoliation, and the flecked appearance, as well as considerable symmetry, contrast with the smooth subcuticular stains of the first; co-existent signs denote the second; and the absence of inflammation and of abundant desquamation mark it from the last-named. Erythrasma is distinguished by the narrower localisation, the redder colour of the patch, and the greater minuteness of the fungus. *See* ERYTHRASMA.

TREATMENT.—If there be a low condition of health, tonics and a nourishing regimen are called for; but local measures usually suffice. The skin should be scrubbed in a soft soap or other alkaline bath; and when dried it should be carefully treated with the sulphide of potassium ointment, any of the mercurial ointments diluted, or a lotion of bichloride of mercury, or of one part of hyposulphite of sodium to eight of water. Previous sponging of the surface with vinegar increases the efficacy of this last parasiticide, which is the most convenient. Friction with strong alcohol or ether will often cure a small patch instantaneously. Daily use of sulphur soap gently stimulates the skin and checks the growth of the mould. The inner clothing, especially the flannels, must be disinfected or destroyed.

ERASMUS WILSON. E. D. MAPOTHER.

TINKLING, METALLIC.—A sound of a peculiar quality, which the name sufficiently defines, occasionally heard on auscultation in connexion with cavities in the lungs, or when air and fluid are present in the pleura. *See* PHYSICAL EXAMINATION.

TINNITUS (Lat.).—SYNON.: Fr. *Bourdonnement d'Oreilles*; Ger. *Summen*; *Klingen.*—Tinnitus, a term which is commonly used when speaking of noises in the ears, is a frequent symptom in many diseases of the external, middle, and inner ear. It is usually present in all those conditions where there is undue pressure on the labyrinth; for instance, when there is pressure on the tympanic membrane from cerumen, imperfect entrance of air into the tympanum, due to obstruction of the Eustachian tubes, or effusion within the tympanic cavity. It accompanies most inflammatory diseases of the external or middle ear; follows injuries to the tympanic membrane, and blows on the head or ear; may occur in aneurysm at the base of the skull; and is a prominent symptom in all nervous affections of the auditory apparatus, as well as in many states of disordered hearing where the ear is healthy. So infinite are the degrees and variations in this symptom, that there is probably no known sound to which it has not been compared by patients. When tinnitus is due to some curable local cause, the symptom rapidly disappears with its removal. When, however, it accompanies the deafness in nervous affections, it is often the more troublesome symptom of the two, and the less amenable to treatment. Strychnine is the most useful tonic in ear-affections, and quinine the least suitable, as this drug exercises a distinctly injurious effect, if taken in large doses. *See* EAR, Diseases of; HEARING, Disorders of; and VERTIGO.

W. B. DALBY.

TITUBATION (*titubo*, I stagger).—A term for staggering or stumbling gait. *See* CEREBELLUM, Diseases of; and VERTIGO.

TOBACCO, Poisoning by.—SYNON.: Fr. *Empoisonnement par le Tabac*; Ger. *Tabakvergiftung.*—The minor effects of tobacco-poisoning—nausea, depression, vomiting, vertigo—are well known to the incipient smoker. Fatal poisoning by tobacco rarely occurs, except through its ignorant administration by mouth or rectum. Cases of nicotine-poisoning are still more rare, this, the volatile active alkaloid of tobacco, not being readily procurable.

ANATOMICAL CHARACTERS. — After death from tobacco-poisoning the organs and tissues have a tobacco-like odour, and the odour of nicotine becomes more pronounced on treating them with liquor potassæ. Turgescence of the brain has been described; but, beyond the odour, there is nothing diagnostic in the appearances.

SYMPTOMS.—When a strong decoction of tobacco or snuff is administered, either by mouth or rectum, very speedily—usually in about five minutes—the patient is seized with vertigo, acute abdominal pain, nausea, and vomiting. The skin is pallid and bathed in perspiration. Stupor supervenes, with partial or general convulsions, and stertorous respiration; and death may result in fifteen or twenty minutes, preceded by dilatation and insensibility of the pupils. When the alkaloid, nicotine, is swallowed, insensibility supervenes almost immediately; the pupils are widely dilated; respiration is speedily suspended; and the patient dies in three or four minutes.

The toxic effect on vision of the *continued* use of tobacco is described in the article EYE, AND ITS APPENDAGES, Diseases of.

DIAGNOSIS.—The *odour*, coupled with the above described symptoms, would leave no doubt as to the nature of the case. Usually there is a history of administration

Prognosis.—The prognosis is in all cases unfavourable. *Fatal dose.*—Thirty grains of tobacco are said to have proved fatal. A drop or two of nicotine would doubtless prove fatal.

Treatment.—The treatment of poisoning by tobacco consists in the exhibition of emetics, followed by tannic acid freely in any form, to render the alkaloid insoluble. Strong tea, coffee, and stimulants should also be administered. Iodine, dissolved with iodide of potassium, has been recommended; but is probably of little efficacy, and is undoubtedly irritating to the stomach. Twenty to thirty minims of tincture of nux vomica may be given, and repeated at intervals; or, better, a hypodermic injection of $\frac{1}{25}$ grain of the nitrate or other soluble salt of strychnine may be administered.

Thomas Stevenson.

TOKELAU RINGWORM. — *See* Tinea Imbricata.

TONE, Want of.—This expression, although commonly employed in a somewhat loose and unscientific manner, is sufficiently understood in the main. To appreciate its meaning, it is first necessary to inquire what tone is. In the widest sense of the term, a person may be described as being *in tone* when his organs individually discharge their functions in a perfect manner, and act harmoniously as a whole, just as a violin is said to be *in tune* when melody can be educed by striking its individual strings. More correctly, tone is applied to a condition of the muscular system, as signifying that state of tension in which voluntary muscular efforts can be produced and continued with a healthy and pleasurable feeling; and also to muscular organs, to indicate a certain degree or power of contraction of their walls.

Ætiology and Pathology.—Various factors combine to produce and maintain muscular tone. First, this state is dependent on a proper supply of *nervous energy*; secondly, *nourishment* and *oxygen* must be furnished in abundance; thirdly, the *products of waste* must be thoroughly removed from the system; and fourthly, the *work* required of the muscular tissue must not be excessive, that is, a certain amount of rest must be afforded to it.

Want of muscular tone results, then, from failure of any of these conditions.

1. *Nervous failure.*—Whatever view may be taken of the nature of nervous and muscular force, modern research has shown that they are intimately connected with each other. If the nerve-supply be cut off, muscles waste; and *vice versâ*, if the muscles remain unemployed, their nerve-centres suffer. The effect of nervous disease or disorder in producing loss of muscular tone is illustrated by such neuroses as hysteria and epilepsy, by some forms of mental disease, and by the large but indefinite class of cases known as 'nervous debility,' of which mental strain, anxiety, sexual excess, or masturbation and alcoholism are frequently the exciting causes.

2. *Failure of nutrition.*—Deficiency of the blood-supply immediately lowers muscular activity, in consequence of interference both with the nutrient and the oxygenating processes. It is on this account that want of tone is found in anæmia, in convalescence from acute diseases, and to a certain extent even in chronic dyspepsia. Want of oxygen and impurity of the atmosphere lead as distinctly to lassitude; and, if long continued, to lowering of muscular energy and loss of tone, as amongst the inhabitants of large towns, and in persons employed in close, ill-ventilated rooms.

3. *Retention of waste products.*—When muscles are called into action certain compounds are formed within them, which must be eliminated by being passed back into the circulation and excreted. The lungs, skin, kidneys, liver, and bowels must, therefore, discharge their functions properly to keep the muscular system in tone. We have here the explanation of a very common class of cases of want of tone. Many persons, either from choice or from necessity, habitually take an amount of active bodily exercise insufficient for the removal of the waste products from the muscular and other systems. In the former case this is the result of indulgence in abundant rich food, combined with lazy habits, confinement to warm 'relaxing' rooms, and the avoidance of 'bracing' exercise. In the latter case, the metabolic inactivity is referable to enforced confinement in sedentary employments, often of an exhausting kind, carried on perhaps in an impure atmosphere, or throwing a continuous strain upon one set of muscles, such as those involved in standing or sitting. Both these classes of cases also are met with chiefly in large towns, and they constitute a considerable proportion of the persons who 'require tonics.'

4. *Muscular exhaustion.*—Excessive muscular exercise leads to loss of tone: first, by interfering with nutrition, which is most active during rest; secondly, by wear and tear; and thirdly, in the case of hollow muscular organs, such as the intestines (the muscular walls of which have to resist internal pressure), by gradual exhaustion of muscular irritability from continuous excitement, or possibly even by over-stretching and dislocation of the fibres. The first two forms of muscular atony are well illustrated by certain instances of cardiac exhaustion; the third form is met with not only in the alimentary canal, but in the bladder, in the blood-vessels, and indeed in all muscular tubes and ducts, when over-distended by solid, fluid, or gaseous contents.

5. *Combined causes.*—In many cases two

or more of the causes mentioned under the preceding heads are combined, and give rise to want of tone or atony. Thus in a large class of cases of debility with which practitioners in large towns are familiar—and which especially includes young female subjects engaged in business—overwork, impure air, insufficient light, badly cooked or otherwise improper food, the constant strain of the muscles of the legs and back without sufficient movement, and frequently many other circumstances injurious to the nervous system, are all combined. Again, the subjects of chronic nervous affections, such as epilepsy and hysteria, are too frequently overfed, nursed in warm rooms, and spared every form of healthy exertion, with the result of producing a flabby, atonic state of system.

Symptoms.—Want of tone in the muscular system generally is characterised by a number of symptoms, which are all more or less ill-defined and difficult to describe, being chiefly of a negative and subjective kind. The chief of these are a peculiar feeling of want of muscular vigour; weakness, heaviness, and even aching of the limbs; languor, inability and unwillingness to undertake or to continue any kind of physical or mental exertion, and a desire to remain passive and undisturbed. This reacts upon the mind, causing depression of spirits, melancholy, and other subjective symptoms.

The symptoms of want of tone or atony of muscular organs vary greatly with the part affected. Thus atony of the stomach is characterised by a familiar form of dyspepsia, which is called 'atonic;' atony of the bowels is chiefly attended by constipation and flatulence; atony of the bladder is associated with retention of urine. Ulcers are said to 'want tone' when the healing process flags.

Treatment.—It will be gathered from the preceding remarks that want of tone, whether general or local, is a condition which calls for very different kinds of treatment, according to its cause. One of the principal reasons of the want of success which frequently attends attempts to restore tone to the system is failure on the part of the practitioner to appreciate this truth, and to discover and remove the cause or causes of the morbid state. Tonic drugs suggest themselves only too readily as the proper means to be employed; and so great is the number of remedies which go by this name, and so complex are the combinations in which they are now presented by the pharmacist, that recourse is often had to them before an accurate estimate has been made of the direction in which the system or the affected organ is really at fault, and hence injury, not benefit, results. These remarks apply both to loss of tone generally, and to atony of special organs. Thus it happens that the best tonic measure in one case may be rest, in another case exercise; in a third case food and stimulants may be urgently called for; in a fourth case depletory measures are essential at the commencement of treatment. Time is an equally important factor in the process of restoration to tone. This is especially true in the instances where rest is necessary; but even in the very opposite class of cases, where exercise is demanded, this regimen may need to be carried on for a long time, being commenced with caution and slowly increased.

The details of tonic treatment are indicated in a special article (*see* Tonics). Here it need only be added that when the nervous elements are distinctly deficient in activity, strychnine, cinchona, phosphorus, and cod-liver oil appear to be specially indicated, whilst galvanism and massage may be useful. Massage is a most potent agent in increasing bodily tone. But it requires careful regulation, as in some patients it proves too exhausting—it may be from too quick destruction of the muscular tissues, and insufficient elimination of the waste products (*see* Massage). On the other hand, Dr. Weir Mitchell's treatment, where massage is combined with forced feeding and seclusion, is of great value where failure of tone arises chiefly from a badly nourished nervous system. Alcoholic stimulants and iron are best adapted to cases in which nourishment and oxygenation have fallen below par. When the activity of the organs is diminished from accumulation of waste products, we must have recourse to moderate cholagogue purgation, to such diuretics as digitalis, to diaphoretics, and especially to change of occupation, and exercise of such a kind in an open healthy atmosphere as shall bring all the voluntary muscles into action, and stimulate if possible every bodily function. In the converse class of cases, where exhaustion is the result of over-exertion, we have, after removing the cause, to exhibit antispasmodic or even sedative drugs, such as belladonna and opium, which are especially useful in the first stage of atony of the stomach and alimentary canal, as well as in atony of the bladder.

Finally, no class of remedies is so likely to prove efficacious in restoring tone as that of mineral springs and baths. Where these are chosen with due discrimination, every one of the indications for treatment may be fulfilled. In *nervous failure*, whatever may have been the exciting cause, the change of air and scene, the regulated life and the freedom from daily cares, all tend to restore the due working of this important factor in maintaining a due tone of the whole system. The same remarks apply to *failure of nutrition*, where early hours and exercise, which form a part of the regimen at every Spa, are so conducive to an improved tone of the muscles, voluntary and involuntary, of the body. But it is in cases of *retention of waste products* that natural mineral springs and baths play so important a part. Doubtless the principal agent is water, and the different saline or other ingredients are merely subsidiary helps. Yet even the mere flushing of the system is not to be despised; and in no other fashion can it be so thoroughly—if not always very pleasantly—secured. The fourth cause—*muscular exhaustion*—is one also which can be very successfully combated at a watering-place. One of the most necessary injunctions which require to be laid down by the bath physician is attention to graduation of the amount of exercise. The improved sleep, too, following on better digestion, inhalation of pure air, and increased elimination, tends greatly to give tone to the system by ensuring sufficient intervals of rest. Enough has been said to show that mineral waters, bathing, and the modern system of massage available at all Spas, must do much to counteract the bad effect of the combined causes of failure of tone.

WILLIAM BRUCE.

TONGUE, The. — SYNON.: Fr. *La Langue*; Ger. *Die Zunge.*—Apart from its own particular diseases, which are described in a separate article (*see* TONGUE, Diseases of), the tongue, as is well known, gives important clinical indications regarding various morbid conditions affecting the general system as well as many local diseases. To 'look at the tongue' is one of the first acts of 'clinical examination' which even the merest tyro in the medical profession performs; but there is much that is indefinite and uncertain in the ideas as to what this examination is intended for, and what information it affords. The limits of the present article will only permit of a brief summary of the subject; and for valuable practical details the reader is referred to the *Lumleian Lectures* for 1888, by Dr. W. H. Dickinson, on 'The Tongue, as an Indication in Disease.'

MODE AND OBJECTS OF INVESTIGATION.—In general terms it may be stated that we examine the tongue, for clinical purposes, with reference, first, to its *subjective sensations*; secondly, to its *movements*; and, thirdly, to the *objective characters* which it presents.

1. Its *subjective sensations* chiefly include ordinary tactile sensation, and the sense of taste. In most cases we rely for information on these points upon the statements of patients; but under certain circumstances common sensibility may be tested experimentally by some suitable instrument; and taste, by applying different articles to the tongue with a brush, or in other ways (*see* TASTE, Disorders of). Sir Richard Quain has called the writer's attention to a peculiar sense of heat or burning, sometimes felt in the tongue, which seems to be associated with the gouty diathesis.

2. The *movements* of the tongue are studied by watching them directly; and by noticing any abnormal affection of speech or deglutition arising from defect or disorder of these movements. A peculiar thickness of speech, or an inability to swallow properly, may result from this cause; and in extreme cases articulation and deglutition may become impossible. To examine the tongue directly as a motor organ, it should first be looked at while in the mouth, both at rest and when the patient moves it from side to side, or in other directions; then he should be directed to put it out, and to perform similar movements when the tongue is protruded. This mode of investigation gives important information in certain cases.

3. The *objective examination* of the tongue in itself is of far more frequent application than the methods just considered, being indeed called for and ordinarily practised in every case, although it may not necessarily afford any positive information. No patient thinks his case properly investigated unless he is told to put out his tongue. The examination is usually carried out by inspection; but it may also be requisite, and very instructive, to feel the tongue with the finger. In looking at the organ, an endeavour should be made to inspect its entire upper surface, and for this purpose the patient should be directed to open the mouth, and protrude the tongue as far as possible, a good light being also needed for observing it. In some instances, as in infants and rebellious children, as the result of congenital malformations or wearing false teeth, in many low febrile cases, and in certain nervous diseases, the tongue must be examined while in the mouth, as the patient either cannot or will not put it out properly; for this purpose it is sometimes necessary to open the mouth somewhat forcibly, but with due care, and it may be desirable to employ some artificial light. For more minute information in some cases it is requisite to scrape the surface of the organ, and to examine microscopically what is thus removed. The points to be noticed in the objective examination of the tongue are: (*a*) Its size and shape as a whole, as well as the characters of its point and margins. (*b*) Its condition as to firmness or flabbiness. (*c*) The colour of the mucous membrane. (*d*) Whether the surface is normal, smooth and glazed, being more or less denuded of its usual epithelium, or presenting a dry membranous covering, furrowed, fissured, or otherwise altered. (*e*) The condition and appearance of the papillæ, especially the fungiform papillæ. (*f*) Whether the tongue is moist, sticky, or dry. (*g*) The absence or presence of any accumulation on the dorsum of the organ, commonly known as 'fur'; and, if present, its arrangement, thickness, colour, and other general characters, as well as in some cases

microscopical appearances. It may be remarked that in relation to this examination of the tongue it is often advantageous to notice the condition of the mouth generally, but especially of the gums and teeth, and of the lips. Further, the patient may afford information with regard to the objective conditions of the tongue, not coming immediately under the notice of the practitioner, such as whether it is much furred on waking in the morning, or if it is inclined to dryness.

It is desirable to offer a few remarks respecting abnormal covering or *fur* on the tongue. This varies much in its extent, thickness, and characters. As regards its general distribution, it may cover the whole surface of the organ; or only its posterior or anterior part, one lateral half, or even a limited patch when due to local causes. The covering may be a mere film, or of considerable thickness. Its chief colours are white, whitish-yellow, yellow, yellowish-brown, brown, brownish-black, and black. It is either moist and easily separated, sticky and viscid, or dry, being then often cracked and peeling off. It usually clears gradually from the tip and sides towards the centre of the tongue, sometimes in strips; sometimes it breaks away abruptly in scales. Under certain circumstances fur appears and disappears with great rapidity.

In a very instructive classification of tongues, Dr. Dickinson employs the following terms: (1) *Stippled* or *dotted*, where the papillæ are separately capped with a minute white patch. (2) *Coated*, where the spots coalesce and become confluent, so that the covering is continuous, the intervals between the papillæ being also more or less filled up. (3) *Plastered*, where the coat is thick, uniform, and conspicuous, and often looks as if laid on with a trowel. (4) *Furred* or *shaggy*, in which there is great elongation of the papillæ, which remain separate from each other, at least at their extremities, so as to give a shaggy look, or one suggestive of coarse hair or fur. (5) *Encrusted*, in which the papillæ are concealed by an incrustation, or thick felted coat, usually dry and brown, by which the surface is overlaid.

As regards the nature of the changes in the varieties of abnormal tongues just indicated, microscopical examination shows that in most of them the papillæ are elongated. The white coating is found to consist mainly of accumulated epithelium, which, according to Dr. Dickinson, is the result chiefly of overgrowth. In the superficial layers of many accumulations on the surface of the tongue, especially the dark encrusted form, there are also present the remains of food, amorphous material, fat globules, blood or altered blood and pigments, different micro-organisms, especially bacilli and micrococci, and sometimes the *oïdium albicans*. In the deeper parts of the epithelial structure, more especially in the Malpighian layer, there is often much profusion of nucleation or cell-growth, and the corium is in many cases distinctly hypernucleated and often over-injected. More rarely leucocytes are extruded within the papillæ and elsewhere (Dickinson).

With reference to the immediate causation of these abnormal conditions of the tongue, Dr. Dickinson concludes that the formation of more or less coating, with lengthening of the papillæ, depends partly on disuse of the organ, with want of rubbing and washing, and consequent deficient removal of the epithelium; but mainly on increased overgrowth, associated probably in some cases with a morbid poison in the system, but chiefly with pyrexia, the coat increasing in degree in proportion to the temperature, up to a certain point. Dryness of the tongue he attributes principally to deficient secretion of saliva; but it may also be due partly to habitual openness of the mouth during sleep, pyrexia, or general dehydration of the body, from deprivation of water or excessive discharge, as in diarrhœa and diabetes. The condition to which this observer specially applies the term 'furring,' as well as incrustation, he considers as essentially connected with want of saliva. Incrustation is a secondary process, in which various matters accumulate on the surface of the tongue, including parasites. The brown colour he refers chiefly to dryness, as many animal substances dry brown; partly to staining food and medicines.

The condition of tongue in which its surface is abnormally smooth, bare, and denuded, also calls for brief notice. This may be general or partial, and usually follows the removal of a coating or incrustation; but it may be a primary change. It presents various degrees, the organ being at the same time more or less red, and generally dry. A glazed, shining, or polished appearance is common. In extreme cases this variety of tongue becomes intensely red and raw-looking, being compared to raw beef; and it may be excoriated or cracked. In describing the minute changes, Dr. Dickinson states that the epithelium and the papillæ are removed down to the level of the Malpighian layer, but this usually remains, and becomes covered with fresh horny epithelium, forming a thin membrane. Should the denuding process extend further, the Malpighian layer itself is removed, exposing the corium; and this structure is sometimes encroached upon, even almost down to the muscular fibres. Vascular injection, hypernucleation, and the extrusion of leucocytes often take place; and in some cases there is a general inflammatory infiltration of the superficial parts. A completely bare tongue is comparatively rare, and such a degree of change is generally limited in extent. The variety of tongue now under consideration is that on which aphthous growths are most liable to occur. It implies failing nutrition. The appearances are due partly to want of epithelial covering; but the exposure resulting from loss of this covering also causes irritation and dryness. Dr. Dickinson attributes the changes partly to want of saliva.

Clinical Indications.—In the following remarks it is intended to call attention to some of the principal conditions in which the tongue affords useful information, and to indicate the main characters associated therewith. Dr. Dickinson affirms that 'the tongue is an index of constitutional states, seldom of individual diseases'; 'it seldom points to solitary organs or isolated disorders, but is rather a gauge of the effects of the disease upon the system than an indication as to the locality of it.' Allowance must always be made for individual peculiarities in the shape or size, and in the appearances presented by this organ; for the effects of certain habits, such as excessive smoking, or chewing tobacco and other substances; for changes in colour due to taking iron or other medicines; and for any local irritation. Moreover, most people, but especially those who sleep with the mouth open, have a more or less furred tongue in the morning, which is of no special importance, or it may tend to dryness; while in some individuals its surface presents constantly a thick coating, without evident disturbance of any organ, appetite being excellent, and the digestive functions performed in a most satisfactory manner. On the other hand, a perfectly clean and healthy-looking tongue may be associated with severe dyspeptic symptoms, or even with serious organic disease of the alimentary canal or its related organs. Many persons have the surface of the tongue more or less furrowed as the normal state.

1. **Nervous Diseases.**—In this class of diseases the tongue often affords information of much value, and it is here that its sensations and movements are mainly disordered. In many cases of cerebral lesion, one half of the tongue is paralysed in its muscles, so that the organ is unsymmetrical in the shape of its two sides; and deviates when in the mouth to the healthy side, but when protruded towards the paralysed side. In exceptional cases the entire organ is affected, so that it cannot be protruded or even moved. The way in which a patient attempts to put out the tongue when asked to do so, may be made use of to indicate the state of consciousness in various conditions affecting the brain. In many cases of cerebral disease the tongue shows a marked and speedy tendency to become thickly furred, and very foul. This is well seen in cases of apoplexy due to hæmorrhage in connexion with the brain.

The tongue is specially affected in certain peculiar nervous diseases, particularly labio-glosso-laryngeal paralysis, many cases of diphtheritic paralysis, general paralysis of the insane, and extreme cases of wasting palsy. Beginning with slight indications of loss of power, as tremulousness, thickness of speech, and difficulty in swallowing, the affection is liable to end in complete paralysis of the organ, which may also involve its sensibility. These results depend on disease involving the roots of the nerves supplying the tongue. The organ may also be thus affected in various degrees, owing to some morbid condition implicating its nerves in their course or at their origin. When completely paralysed, the tongue in time comes to present the appearance of a sodden mass lying in the mouth. In cases of severe neuralgia of one side of the face, the tongue occasionally presents peculiar appearances, such as unilateral furring, thickening of the mucous membrane, or enlargement of the papillæ; coating of one side of the tongue has also been noticed in connexion with painful teeth (Hilton). The tremulous and foul tongue of acute or chronic alcoholism may be mentioned under this head. Dr. Dickinson has often noticed the tongue to be white and sodden-looking after an exacerbation of nervousness, but attributes this to a want of saliva. Signs of the organ having been bitten may be useful in the diagnosis of obscure cases of epilepsy. Jerking and irregular movements of the tongue are very striking in many cases of chorea. During attacks of migraine its surface usually becomes much furred.

2. **General Conditions and Diseases.** The tongue is usually markedly altered in the febrile state, whether associated with specific fevers, or with inflammatory or other diseases. It becomes covered with more or less fur, often of considerable thickness, and usually either white or yellowish-white. In particular fevers the organ commonly presents peculiar characters. Thus, in many cases of typhoid fever it is small and irritable, with enlarged papillæ, and a thin whitish or yellowish fur; it may become red, smooth, and glazed or shining. In this disease it may also be peculiarly tremulous, which has been regarded as a bad sign, indicating deep ulceration of the intestine. In scarlatina the papillæ tend to become peculiarly prominent as well as injected, projecting through the fur, the tongue presenting the so-called 'strawberry' appearance; this condition may, however, be met with in other diseases. In diphtheria the tongue may exhibit a diphtheritic deposit upon its surface. There is generally a very thick, creamy coating in acute rheumatism, as well as preceding and during attacks of gout, and in the latter especially it often becomes yellowish or brownish. In acute pneumonia also the tongue is often thickly plastered, but presents much variety. In the 'typhoid state,' whatever this condition may be associated with, the tongue

tends to be dry, and usually covered with a brown or even blackish crust, looking as if it were baked. It is often very red and irritable in itself, and occasionally the typhoid tongue has little or nothing on its surface, but is very dry, deeply red, like raw beef, and fissured. The organ may be in such a condition that it can scarcely be moved at all. At the same time sordes are present on the teeth and gums. The red, raw, and dry tongue is generally associated with exhaustion, especially when this is due to exhausting discharges, particularly of pus; and it is linked with the constitutional state described as hectic. It not uncommonly occurs, however, in various conditions producing prostration and depression, apart from discharges, and these are often connected with the abdominal organs. In malarial fevers the margins of the tongue are said to present sometimes a faint bluish tinge.

It may be remarked here that the tongue not uncommonly affords evidence of constitutional syphilis, owing to the past effects of this disease upon the organ. It may also indicate the general tone of the system, being often large and flabby when this is below par.

3. Conditions affecting the Blood and Circulation.—The tongue often exhibits abnormal characters, due to the state of the blood or circulation. Thus, in anæmia it is more or less pale; generally large, flat, broad, and flabby; and frequently indented at the sides by the teeth. In the plethoric condition it is also large, but tends to be of a deeper colour than normal, and may present a venous tint. The anæmic tongue is frequently quite clean, though this will depend much on its associations; but the tongue met with in plethora is generally furred. A temporarily congested condition of the digestive organs and liver is supposed to be accompanied by a corresponding plethoric state of the tongue. Any cause of general obstruction to the venous circulation, or of interference with the due aëration of the blood, whether seated in the heart or lungs, is likely to give rise to enlargement of the tongue, and to make it assume a congested, or even a cyanotic appearance in marked cases, such as those of congenital malformation of the heart. It occasionally happens that some local obstruction, affecting the large veins in the thorax, as from the pressure of an aneurysm, produces a similar condition of the tongue. In his classification, Dr. Dickinson applies the term *cyanotic* to a particular variety of tongue, which is injected, hypernucleated, with excess of deep epithelium.

4. Affections of the Alimentary Canal and its Related Organs.—The tongue is commonly regarded as of peculiar importance in relation to morbid conditions of the digestive apparatus and liver, but Dr. Dickinson's observations do not support this idea, and he attributes the changes presented by the organ rather to the pyrexia or other constitutional disturbance associated with these conditions. As already stated, there is no definite relation between the state of the tongue and the performance of the digestive functions, or the presence or absence of even serious disease, but at the same time there are certain general indications which may be worthy of note.

(*a*) The tongue is peculiarly liable to be altered in local affections of the mouth and throat. In catarrh of these parts it is more or less coated. In tonsillitis there is usually a very thick covering; and it may be most marked on the side of the inflamed tonsil. Even a local irritation, such as that caused by decayed teeth, may originate a fur, and it is under such circumstances that it is liable to be localised. Associated stomatitis may explain the state of the tongue in some cases of gastric catarrh or inflammation.

(*b*) In any acute disorder of the alimentary canal the tongue tends speedily to become coated, usually either white or yellowish-white, but it may be more or less brown. This is seen in so-called acute dyspepsia, gastric catarrh, and hepatic disorders. The fur often clears away very speedily when the cause subsides. In severe acute gastritis the organ frequently presents a strikingly red and irritable appearance, especially at the tip and edges, with enlarged papillæ, and a tendency to dryness. In acute intestinal obstruction the tongue becomes stippled at an early period, or coated and dry.

(*c*) In chronic forms of dyspepsia and gastric catarrh, the tongue often presents abnormal appearances. In the atonic variety it is usually large, flat, soft, and flabby; frequently marked with the teeth; and more or less furred, though it may be quite clean. In the irritative form it tends to be small, elongated, and pointed; contracted and firm; red and irritable; with enlarged papillæ; and generally only having a thin white fur, through which these papillæ project, but it may appear unusually clean and raw-looking. The organ may present characters more or less similar to those just described, in those cases where the food passes rapidly out of the stomach into the duodenum in an undigested state. In the more grave diseases of the stomach, namely, cancer and ulceration, the tongue has no special characters, and indeed is often very healthy-looking. Dr. Dickinson has not been able to discover any state of tongue especially connected with dyspepsia or ulcer of the stomach.

(*d*) The relation of the tongue to affections of the intestines is indefinite. The bowels are often much deranged in their functions, or diseased, without any abnormal appearances being exhibited by the organ. It may be said, however, that constipation, especially if habitual, tends to make the tongue large and furred, particularly if associated with portal congestion and deficiency of bile. Cases of prolonged constipation have not uncommonly been met with, however, in which it has remained perfectly clean and normal. Chronic accumulation of fæces in the rectum seems to give rise to thick coating, which Dr. Dickinson attributes to general disturbance, and probably pyrexia connected with morbid absorption. Diarrhœa tends speedily to affect the tongue in various ways. There is scarcely any condition in which the tongue becomes more rapidly dry, coated, furred, and encrusted, than severe diarrhœa. In dysentery, especially with hepatic abscess, it often becomes shrunken, red, smooth and polished, or fissured.

(*e*) As regards the hepatic apparatus, portal obstruction is believed to cause an enlarged and congested state of the tongue, but this is very doubtful. It tends to become more or less coated in biliary disorders, especially when acute; and is often very foul in cases of obstructive jaundice, when it may also be coloured yellow.

5. **Special Diseases.**—In diabetes mellitus the tongue is often peculiarly irritable, red, clean, cracked, and dry. In acute peritonitis it is usually remarkably small and contracted, also red and irritable, with but little fur, and tending to dryness. In advanced cases of phthisis, especially with a high temperature, it frequently becomes red and raw, and exhibits enlarged papillæ; the occurrence of thrush upon its surface may also be a sign of approaching dissolution in this disease. These illustrations will suffice to point out the special information which the tongue may afford as regards particular diseases.

Conclusion.—By a consideration of the characters of the tongue, it will be seen from the foregoing remarks that important and valuable indications are often afforded, not only as regards diagnosis, but also in relation to prognosis and treatment. Therefore it is essential that its characters should be properly studied in every case, bearing in mind the three main clinical aspects which it presents to the practitioner, namely, its sensibility, movements, and objective characters. Frederick T. Roberts.

TONGUE, Diseases of.

—Synon.: Fr. *Maladies de la Langue*; Ger. *Krankheiten der Zunge*.

The principal morbid conditions affecting the tongue may be thus enumerated in alphabetical order: (1) Chronic Abscess; (2) Adhesions; (3) Atrophy; (4) Cancer; (5) Cysts (mucous); (6) Hypertrophy; (7) Inflammation and Acute Abscess; (8) Leucoma, Leukoplakia; (9) Parasitic Affections; (10) Syphilis; (11) Tongue-tie; (12) Tubercular Ulcer; (13) Tumours; and (14) Ulceration. Aphthæ and thrush are discussed under their respective headings (*see* Aphthæ; and Mouth, Diseases of). The simpler disturbances of the surface of the tongue, of which the practitioner avails himself as an aid to diagnosis, are separately discussed. *See* Tongue, The.

1. **Chronic Abscess.**—This may occur at any age, and its cause is generally obscure. It is most common in front of the circumvallate papillæ, and forms a tense, elastic, more or less prominent swelling, presenting beneath the dorsal mucosa. Its outline is generally quite clear. The membrane over it is free and normal in appearance; the swelling is neither tender nor painful. However prominent, it is not translucent. Growth is very slow, and the history of the swelling may extend over some years. The disease has to be diagnosed chiefly from mucous cyst.

The treatment consists in the application of cocaine, incision, and scraping out the abscess with a sharp spoon.

2. **Adhesions.**—Occasionally the tongue is attached more or less extensively at its sides and under-surface to the corresponding surfaces of the mouth. These adhesions may be congenital, but more frequently they are the result of ulceration or sloughing.

Treatment.—In congenital cases the membranous bands may be divided with scissors or scalpel. Sometimes a well-formed tongue exists, bound down laterally to the jaws: these cases do well. When the tongue is not really formed, treatment is of no avail. Adhesions consequent upon ulceration may be dealt with similarly, but the result is much less hopeful, unless a mucous flap, from a part which will not lie in contact with another raw surface, can be twisted into the wound made. The writer is not acquainted with any case in which the transplantation into the mouth of a piece of mucous membrane from another animal has succeeded.

3. **Atrophy.**—Atrophy of the tongue may be either unilateral or bilateral. It may result from either acute softenings or chronic scleroses of the nuclei of the twelfth nerve in the medulla, and in both of these cases the palsy is usually bilateral, the two nuclei being so close together as to be almost necessarily involved by even a small lesion. Injuries to the nerve-tract between the centre at the lower end of the ascending frontal convolution and the nucleus cause paralysis, with but little and late wasting. Injuries below the nuclei, on the other hand, lead to rapid wasting of the tongue on the side of the injury.

Treatment.—Treatment must be directed to the cause of the complaint. *See* Hypoglossal Nerve, Diseases of.

4. **Cancer.**—Ætiology.—Cancer of the tongue is most frequent between the ages of forty and forty-five; it may occur at any

age after twenty-five, but is rare under thirty-five. It is more than twice as common in men as in women. Irritation from a tooth or hot smoke sometimes seems to be the exciting cause; again, the growth may supervene upon leukoplakia, glazed red tongue, a wart, or a chronic gummatous ulcer. Locality has a distinct influence.

Description.—Squamous epithelioma is the only form met with in the tongue. Its usual seat is the edge in the middle third, but it may begin at any spot. It starts as an ulcer, a fissure, or a wart—sometimes the patient says, ' as a lump in the tongue '; but growing as it does from the epithelium, this ' lump ' is always intimately connected with the mucosa, and the epithelium is never normal over the whole mass, but is either destroyed by ulceration or is papillary. The earliest characteristic point is induration of the base of the lesion, from invasion of the mucosa by epithelial cells and round-celled infiltration about them; the edges of an ulcer or fissure become similarly thickened. The epithelium on the surface usually undergoes degeneration and is cast off, thus leading to the formation of an ' ulcer,' at the base and edges of which the tissues are being progressively invaded by growing epithelial columns. This invasion is sometimes more marked along the surface, at other times it takes place chiefly towards the substance of the tongue. It is sometimes slow, again rapid, and is almost always so much more rapid than the 'ulceration,' mentioned above, that induration round the ulcer is well marked. Rarely papillary masses project from the surface of an epithelioma, destruction being reduced to a minimum ; unfortunately it is in these cases that infiltration of the base also is apt to be least marked, the products of epithelial multiplication escaping towards the surface instead of being pressed into the substance of the part. As the 'ulceration' and infiltration extend into the substance of the tongue, to the floor of the mouth, the jaw, the fauces or soft palate, the movements of the tongue become more limited, till ultimately it may be quite bound down. Sooner or later the submaxillary glands, or those at the base of the carotid triangle, swell and become painful. They may remain of small or moderate size, or may grow rapidly and discharge or fungate through the skin, and this with but a small growth in the mouth. Extension to distant organs by the circulation is rare. Pain may be slight or even absent, but, as a rule, it is severe, radiating over the whole distribution of the fifth nerve and often to the region of the small occipital. The tongue is tender and sensitive; when fixed, it fails to push food between the teeth for mastication. Ptyalism is constant, and may be very marked. The saliva is ropy, and is expelled with difficulty. The ulcer discharges into the mouth, while sloughs form upon its surface and putrefy; hence mouth and breath become offensive. Perhaps in relation with the increased secretion of ropy saliva the submaxillary gland is large, firm, and easily felt. In consequence of inability to take sufficient food, of chronic putrid poisoning, of pain and anxiety and other influences connected with the nature of the growth, the patient loses health and strength steadily. Death may result from simple exhaustion; not uncommonly septic bronchitis and broncho-pneumonia quicken the progress. Dangerous or fatal hæmorrhage from the epithelioma is rare. Cancer of the tongue is one of the most painful and most rapidly fatal forms of malignant disease. According to Clarke, its average duration is fifty-seven weeks; if the cases which are submitted to operation are taken by themselves, its average duration is eighty-six weeks. But the statistics of surgeons practising carefully the modern operation of removal of the growth, together with the nearest lymphatic glands, show a better result than this—including a fair number of cases of prolonged immunity. Cancer of the frænum and its neighbourhood should be mentioned, as it is credited with exceptional malignancy. This may be the consequence of imperfect treatment, due to a surgeon's reluctance to draw healthy front teeth (to get a good view), to resect the symphysis, and to remove both the submental and submaxillary lymphatics.

Diagnosis.—The difficulties in recognising a cancer of the tongue vary according as it presents itself under the form of an ulcer, a wart, or a tumour beneath the mucosa. In all cases the diagnosis should be effected before the local disease is extensive, or glands are enlarged; otherwise it is probably too late for successful treatment. A cancerous *ulcer* must be distinguished from a simple ulcer, a hard chancre, a broken-down gumma, and a tubercular ulcer. A simple ulcer generally forms quickly, and bears an obvious relation to its cause—some injury, a sharp tooth, or a projecting part of a tooth-plate. It is less defined in outline than cancer, and induration is absent or slight; the edges are not thick, rounded, raised, or everted; the base is not warty and irregular. A scraping of its surface after cleansing shows but few epithelial cells, and they are of normal appearance. After removal of the irritant, and under suitable treatment, a simple ulcer should heal. Hard chancre affects the apex; is exceedingly rare; of rapid formation up to a certain size; very hard, defined, with smooth edges, and but slightly ulcerated base. The submaxillary glands very soon enlarge, and general symptoms follow. A gummatous ulcer is usually a deep ragged cleft on the dorsum, parallel to the raphé, with thin, irregular margins, undermined and gaping as the tongue is protruded, not at all indurated; in the cavity yellowish sloughs may still adhere; there are often other masses in the tongue-substance, and the surface still more frequently presents evidence of previous ulceration or of superficial glossitis; a history and other signs of syphilis are perhaps obtainable; a scraping of the side of the ulcer after cleansing shows but few epithelial cells; appropriate treatment is successful. Both the simple and the gummatous ulcer may become cancerous; so, if progressive induration leads to the suspicion of cancer, either the ulcer should be at once freely excised, or a good piece should be cut out under cocaine and examined microscopically. A tubercular ulcer in a male over thirty-five may be indistinguishable from cancer. If the ulcer is secondary, the presence of tubercle elsewhere should make us careful. Primary tubercular ulcers of the tongue are rare. They are less indurated, but may, if clean, present pale pinkish granulations not unlike those of a clean epithelioma. Sometimes in deeper specimens muscular fibres may be recognised, laid bare by the progressing ulceration. The effect of medicinal treatment is usually *nil*. It is stated that these ulcers yield a scraping like that of a simple or syphilitic sore. Fortunately, the diagnosis is of less importance here than in the previous cases, for the primary tubercular ulcer, or a secondary ulcer with but slight lesions elsewhere, should be excised.

A *warty* epithelioma resembles a simple wart. The diagnostic point is induration at the base of the epithelioma. No wise man would keep even an undoubted wart on his tongue.

An epithelioma in form of a submucous *tumour* has to be distinguished chiefly from an unbroken gumma. A normal or smooth red epithelial surface over the mass, the absence of definite outline or of marked induration, the presence of syphilitic lesions on the tongue or elsewhere, and a history of syphilis, excite suspicion as to the nature of the growth. Full doses of iodide of potassium confirm it.

So much stress has been laid upon the importance of induration in the diagnosis of cancer, that it is right to add that rapidly ulcerating epitheliomata rarely do occur in which there is but little induration.

In no case should the nature of a small ulcer of the tongue in a patient of thirty-five or over be allowed long to remain doubtful. If it does not heal after removal of any local irritant, upon the application of local antiseptics, especially borax and iodoform, and upon the administration of iodide of potassium, a small ulcer should be excised—the operation is so trifling. If there is any doubt about the nature of a larger mass, a portion should be excised for examination.

Treatment.—All epitheliomata, in which it appears possible to remove the whole of the disease, local and glandular, by an operation which the patient seems likely to survive, should be removed without delay by knife or scissors. As a general rule, the lymphatic glands supplied from the seat of disease, and, if possible, the tissue between them and the lesion, should also be removed. If no glands can be felt, and the patient is intelligent and likely to keep under observation, it may be permissible to wait and watch carefully the submaxillary region; but under other circumstances it will be best to remove the glands nearest to the disease. When there is no hope of removing all the mischief, it is still often right to remove that part which lies in the mouth, to relieve pain and the suffering which a cleanly patient undergoes on account of the foul state of the part. Excision of half an inch of the lingual nerve has been performed to relieve pain, and ligature of a lingual artery to check hæmorrhage. The treatment of incurable cases consists in the administration of anodynes in doses sufficient to give relief; in the use of antiseptic washes and powders for the mouth; and in careful feeding.

5. **Cysts.**—In addition to the rare lingual dermoids described under Mouth, Diseases of: 4, and the parasitic cysts (*Cysticercus cellulosæ*, extremely rare; and *echinococcus*, rare), cysts from dilatation of a mucous gland are sometimes met with, and at any age. They are most common where the mucous glands are largest and most numerous—behind the circumvallate papillæ, but they may occur elsewhere in the tongue. They form tense, elastic, circumscribed swellings, sometimes pushing their way into the tongue, at other times projecting sufficiently from the surface to render it evident that they are translucent. They cause no pain, and the mucosa over them is normal or simply stretched.

Diagnosis.—When a cyst is prominent, the diagnosis presents no difficulty except from chronic abscess, which generally occurs in the anterior part of the tongue, and is never translucent. A puncture will decide. When it lies deep and far back, it may be difficult to be sure even that the mass is fluid; the situation, elasticity, and smoothness of surface of the swelling will always suggest a mucous cyst, and here, again, a puncture will prove its nature.

Treatment.—This consists in application of cocaine to the surface, and excision of part of the wall. The interior should be touched over with pure carbolic acid.

6. **Hypertrophy.** — Synon.: *Macroglossia*; *Prolapsus Linguæ.*—Hypertrophy of the tongue is generally congenital; sometimes it follows an attack of inflammation. The enlargement seems to be due to blocking of the lymph-paths; the lips are sometimes similarly affected (*macrocheilia*). In the congenital cases it is often complicated with imbecility or idiocy. The enlargement of the tongue may not be evident at birth. At

first the enlarged organ has a normal appearance; but usually it becomes too large for the mouth, and part is constantly or frequently prolapsed. Gradually, from exposure to the air and constant irritation, the mucosa becomes dry, thick, and callous, or covered with a slimy secretion; the papillæ enlarge greatly. After a time, the pressure of the teeth acts as a line of constriction, and the protruding portion swells from mechanical congestion. The surface of the tongue becomes bluish or brown; the mucosa roughened and cracked; there is a tendency to ulceration and hæmorrhage; the muscles become palsied, and are unable to retract the organ. As time goes on, the lower jaw is pressed down by the superincumbent weight, and occasionally this goes so far as to produce dislocation. The teeth project forwards, the lips are everted, and there is a constant flow of saliva from the mouth. Altogether, the patient's appearance is most unsightly, and his condition very distressing; for with such a tongue mastication and deglutition are difficult, and speech is thick and indistinct.

Treatment.—The redundant part of the tongue must be removed by a V-incision, and the wound sutured.

7. **Inflammation.**—Synon.: *Glossitis.*—Occasionally the surface of the tongue is covered by a crop of vesicles—a kind of herpetic eruption—and this without affecting the deeper structures. At other times the whole substance of the organ becomes acutely inflamed.

Ætiology.—Fifty years ago by far the most common cause of acute interstitial glossitis was the excessive use of mercury, happily now seldom seen. Now it usually arises from 'taking cold.' Sometimes it is due to septic wounds, to wasp-stings, or to taking putrid, corrosive, or acrid substances into the mouth; it may arise in the course of fevers or eruptive diseases, or sometimes without any assignable cause.

Symptoms. — The earliest symptoms of mercurial glossitis, which may be taken as typical, are a foul metallic taste, peculiarly offensive breath, and a red line along the gums, at their junction with the teeth. The gums are tender, spongy, and apt to bleed. As the case advances, the gums, the tongue, and the inside of the lips and cheeks become much swollen. The tongue is sometimes so large as to protrude constantly from the mouth. At its edges it becomes deeply marked by the teeth, and it and the cheeks and gums often ulcerate. The flow of saliva is incessant; the salivary glands are swollen and painful; the teeth ache and become loose, but seldom drop out. The pulse and respiration are hurried. There is great thirst, but the patient has difficulty in swallowing; and he is wholly unable to speak. As a rule, this state of things subsides under proper treatment, but occasionally pus forms in the substance of the tongue, or it may become ulcerated or even gangrenous.

In the acute spontaneous form, the swelling and hardening of the tongue are greater than in the mercurial, and all the symptoms are more severe; the mercurial fœtor is absent. There is a greater tendency to suppuration, localised or diffuse, and to sloughing of more or less of the organ. The fever is often marked. Sometimes the swelling is chiefly at the base of the tongue, though the anterior less swollen part is pushed out of the mouth. Abscess is probable in these cases, and the difficulty in breathing is great.

Treatment.—In acute inflammation of the substance of the tongue, two long incisions going through the mucosa may be needed if the symptoms are urgent. But generally milder measures will suffice, for instance, a saline purgative, or half a drop or a drop of croton oil, together with a mustard-plaster to the throat, and a suitable mouthwash. As a wash, while the inflammation is at its height, there is nothing better than warm borax lotion. Subsequently, a lotion of alum or chlorate of potassium may be employed. At the same time ammonia, iron, quinine, or bark should be given. If an abscess form far back in the tongue, and if it can be localised by special swelling, tenderness, and softness, it should be opened. If pus is set free, the patient experiences immediate relief.

8. **Leucoma.**—Synon.: *Leukoplakia Lingualis et Buccalis*; *Ichthyosis Linguæ*; Hairy Tongue; Smooth Red Tongue; Tylosis.

Definition.—These names have been applied to the results of a chronic superficial inflammation (probably) of the mucosa, resulting now in a white patch or patches; now in hypertrophy of the papillæ, giving the tongue a warty or hairy appearance; again in a swollen, smooth red surface.

Ætiology.—Nothing is certainly known on this point. Mechanical irritation, hot spices and food, ardent spirits, smoking, syphilis, gout, and various forms of dyspepsia are all regarded as causes of this condition. It is rare among women and, under twenty, among men. It does not begin after sixty. It occurs on the lingual mucosa chiefly; to a much less extent on the buccal. It is said not to occur behind the circumvallate papillæ.

Description.—The commonest form is that known as *leukoplakia.* Blue or yellow-white patches (leucomata) form, oval or irregular in outline, smooth on the surface, and showing some degree of resistance when pinched between the fingers. There may be but one such patch. Usually there are no symptoms; sometimes the patches are irritable, casting their epithelial scales, and prone to form fissures and ulcers. With irritability there is more or less ptyalism.

A much rarer form is that known as *ichthyosis*, in which the papillæ are much hypertrophied and covered with horny epithelium. When the filiform papillæ have been specially hypertrophied, the name *hairy tongue* has been given. Lastly, the tongue in some cases becomes smooth, red, and slightly swollen, very sensitive and irritable, and liable to fissures or ulcers.

PROGNOSIS.—Once the disease is established, treatment avails but little as a rule. The danger of the trouble is that it tends in all forms to pass on into epithelioma; induration at the base, ulceration, or warty outgrowth being the signs to be watched for.

TREATMENT.—Every source of irritation must be removed, and any constitutional defect treated, in the hope that good may come. Borax and glycerine lotion, solution of bicarbonate of sodium (grs. xx ad ℥j), or chromic acid (gr. i–ij ad ℥j), may be used as a mouth-wash after meals. Honey of borax, bicyanide of mercury (grs. ij–iv ad ℥j) chromic acid (grs. v–x ad ℥j), or salicylic acid (a saturated watery solution) may be applied directly over the dried part. On no account should irritant or caustic substances be used.

A single obstinate patch may be excised under cocaine. A developing epithelioma will require prompt excision.

9. Parasitic Affections. — The most important parasite connected with the tongue is the *Oïdium albicans*, which is present in thrush (*see* MOUTH, Diseases of). *Hydatid cysts* are occasionally met with; and so is the *Cysticercus cellulosæ*. Among the nematodes the *Guinea worm* (*Dracunculus* or *Filaria medinensis*) and the *Trichina spiralis* have been found. The dracunculus may give rise to an abscess, which will require to be opened; and hydatid cysts may have to be excised.

10. Syphilitic Affections. — These form five-ninths of all the lesions of the tongue which come under our notice. Primary sores are occasionally seen in this situation, but their occurrence is so rare that we need only mention them. For the sake of clearness, it is well to arrange these syphilitic affections into four classes: (*A*) *Superficial Ulcerations*; (*B*) *Mucous Tubercles*; (*C*) *Gummata and Deep Ulcerations*; and (*D*) *Chronic Morbid States of the Mucous Membrane.*

A. Superficial Ulcerations.—Slight superficial ulcerations of the tongue are very common in what is called the secondary stage of syphilis. They are usually situated on the sides, tip, and under-surface of the free portion of the organ; and are often associated with similar ulcerations upon the inside of the cheeks, the lips, and the angles of the mouth. They begin in small inflamed spots, and spread into linear cracks and fissures (rhagades). These are exquisitely sensitive; and, as it is very difficult to keep the tongue at rest, are a source of constant suffering. When these ulcerations heal, whitish scars and cicatrices are left, which are very persistent, and resemble leukoplakial patches.

B. Mucous Tubercles.—Mucous tubercles, when they occur on the tongue, are generally met with about the sides and under-surface of the organ; on the fold of mucosa that is reflected to the floor of the mouth; or on one side of the raphé far back. They occur in the early years of the disease.

C. Gummata and Deep Ulcerations.—Gummata are common in the tongue, varying in size, when they come under notice, from a pea to a marble. Not uncommonly they are multiple, or the principal mass may be set in a diffuse infiltration of the tongue. As a gumma enlarges and softens, the mucosa over it becomes red and smooth, and ultimately it gives way. A ragged opening is thus formed, through which fluid escapes, and adherent slough protrudes. The edges are irregular, thin, and flexible; the walls are not indurated; the opening gapes in certain portions of the tongue. The cavity may heal, or may remain for an indefinite time if no treatment is adopted, and some induration of the walls may supervene. It is in these chronic cases that downgrowth of epithelium (epithelioma) sometimes takes place. So long as a gumma is unbroken, there is strong hope that treatment will cause its absorption. After this, no trace of it may be left upon the surface; but when a gumma has burst, a fissure-like scar results from its healing, and there is more or less induration about it. Sometimes, though rarely, a tongue becomes generally fibroid from the development of gumma-tissue throughout (*chronic interstitial glossitis*). A tongue may thus become deeply and irregularly scarred, enlarged or diminished in size, or much deformed, by alternating contraction and swelling; whilst the mucosa presents, perhaps, patches of normal appearance, white or yellow scars with thickened epidermis, red areas where irritation is still active, and bluish surfaces indicating mechanical congestion from scar-contraction.

D. Chronic Syphilitic Disease.—Various morbid conditions of the mucosa of the tongue are often seen in association with the later stages of syphilis. Sometimes circumscribed patches of the epithelium become dead-white, and drop off, leaving a red raw surface beneath. The epithelium is speedily restored, but another patch becomes affected in a similar manner, and so the disease continues — one patch healing and another desquamating. This is the proper *psoriasis linguæ*. Again, there is a much more extensive disease, to which the name *chronic superficial glossitis* has been given. At the commencement some portions of the membrane present their natural appearance, while others are of a deep red colour and raw-looking. These patches are often oval or oblong. Their surface is smooth and glossy. They are either entirely denuded of epithelium, or this is reduced to an extremely thin layer, and the papillæ are obliterated by distension. These patches are slightly elevated and hard to the touch, in consequence of interstitial thickening. The tongue is swollen. At its edges it takes the impression of the teeth, and the lines thus produced are prone to ulcerate. Sometimes the whole organ has a bluish, congested hue. The mucous secretion all over the affected part is viscid and glairy, giving the organ a peculiar, smooth, glazed appearance; and sometimes the patient's breath is so fœtid that he is offensive to himself and to all about him. He complains of thirst; his mouth is parched, especially at night; and when he wakes in the morning his tongue feels dry and chipped. The disease is, in fact, a chronic glossitis, limited to the mucous membrane. If the more active mischief is checked, the swelling subsides, but the membrane never resumes its healthy character. The patches that have been affected remain smooth and shining. The papillary structure has been impaired, and what is left is in fact cicatricial tissue, a tissue which is sensitive to the contact of hot, acid, or pungent substances, and apt to inflame easily. At a later date, portions of this cicatricial membrane become more completely fibrous, presenting a whitish appearance, and being callous to the touch.

Treatment.—In the treatment of all of these affections it is important to look to the general health of the patient; to see that he smokes little or not at all—any smoke reaching the mouth should be cool; to forbid alcohol, or allow it only in dilute forms; and to order a simple, nourishing diet, from which hot spices and condiments should be excluded.

Mucous tubercles and small ulcers of the secondary stage require a mercurial course. Drying the lesions and painting them once or twice daily with a solution of the bicyanide of mercury (grs. ij–viij ad ℥j) is helpful.

Gummata and gummatous infiltrations disappear most quickly under iodide of potassium. With this, if the gummata are appearing early, or if the patient has never been satisfactorily treated with mercury, or, again, if the iodide does not act quickly, a little mercury should be given. Broken gummata should be treated with a borax wash used frequently, and dusted twice daily, after food and subsequent washing of the mouth, with a powder composed of grey powder, iodoform, and starch in equal parts.

The treatment of chronic superficial glossitis is far from satisfactory. The first object should be to improve the digestion, and to regulate the general health. When there is much superficial soreness, a mouth-wash of borax and glycerine, bismuth and glycerine, or chlorate of potassium, should be ordered. The patches may be painted with a non-irritating mercurial lotion. Irritants should never be used, in view of the danger that these cases may develop epithelioma. The treatment too often consists in combating soreness and irritation, and in watching for increasing induration, indicating the downgrowth of epithelium.

11. **Tongue-tie.**—The tongue is said to be 'tied' when the frænum is either too short or comes farther forward than it should, and thus restrains the movements of the tip, which often seems slightly bifid. The infant cannot put out its tongue, or use it in sucking; and, if allowed to remain, the defect interferes with speech.

Treatment.—Operative interference is required, as follows: Place the child with its head on the nurse's knees, towards the surgeon; raise the tip of the tongue and stretch the frænum with the left forefinger, and snip through the thin part of the frænum with scissors, which will, naturally, be pointed downwards, parallel to the ranine veins. A little pressure down and back into the wound with the left forefinger will still further free the tongue. Mothers often suppose that their children are tongue-tied when, in truth, they are only backward in speaking; so the surgeon should form his own opinion before operating.

12. **Tubercular Ulceration.** — This may be either primary or secondary; the former is very rare. The latter is secondary to laryngeal or pulmonary tuberculosis, suggesting the possibility of auto-inoculation.

Description. — Tubercular ulcers of the tongue are much more common in men than in women. They occur at all ages, are not uncommonly multiple, and rarely reach a large size (one inch square) or a great depth (quarter inch). They are most frequent upon the tip and edge adjacent, then upon the dorsum, and then underneath the free part. They begin as small nodules in the mucosa, which ulcerate, exposing a greyish or yellowish slough. Cheesy stuff may be seen on the surface. If the extension is slow, the edge becomes somewhat raised and rounded, the floor is formed of pale granulations, and the surrounding parts are little or not at all œdematous. There is little or no induration. The edges are redder than the surrounding parts. When the spread is rapid, the edge is thin and ragged, often undermined; the base may be sloughy, or the structure of the eroded tissue may be clear; there is no induration. The symptoms are soreness, sensitiveness, and more or less ptyalism; when advanced, the ulcers may be very painful. The lymphatic glands may enlarge, but this is by no means constant, Microscopically, they present all the characteristics of a tubercular ulcer.

Diagnosis.—Many tubercular ulcers have been excised as malignant—a mistake of little consequence. From gummatous ulcers, the history of syphilis, the position on the dorsum, the depth and thin ragged edges of gummatous ulcers, the absence of tubercle bacilli in them, and the effects of treatment, are the chief points of distinction.

Prognosis.—A small tubercular ulcer may heal, but only to break out again. They probably always prove fatal; or rather, after suffering much from the ulcer, the patient dies from disease of the larynx or lungs.

Treatment.—If the ulcer is primary, or if the primary disease of lung or larynx is early, the ulcer may be destroyed with sharp spoons or the cautery; or a wedge excised, and the sides sewn up. If the primary disease is advanced, and the ulcer is not painful, iodoform and starch in equal parts may be applied after food. If there is much suffering, something operative might be done under cocaine.

13. **Tumours.**—The mucous membrane of the tongue is occasionally the seat of simple warts; and fatty, fibrous, cartilaginous, bony, and nævoid growths have more or less rarely been removed from this situation. They are sometimes deep in the tongue-substance, or more or less polypoid. Sarcoma is almost unknown; cancer is *the* tumour of the tongue.

Treatment.—Small warts may be dried and touched with 30 per cent. solution of chromic acid till they shrivel and fall off; or they may be snipped off, under cocaine, together with the mucosa whence they spring. Larger masses require excision under an anæsthetic. The other tumours mentioned all require excision.

14. **Ulceration.**—Ulcers of the tongue are best classified according to their causes, so far as we know them. We thus get the following groups: *simple*, *tubercular*, *syphilitic*, and *cancerous*. Under the heading 'simple' we include *traumatic*, *dyspeptic*, and *aphthous* ulcers, and the sores on the tongue which form in non-specific leukoplakia, or in ulcerative and mercurial stomatitis. Only the traumatic and dyspeptic ulcers remain undescribed; for the other varieties reference may be made to the special sections.

Traumatic ulcers may be due to injuries of all kinds, but the injury caused by teeth often leads to an ulcer difficult to recognise. A sharp tooth or tooth-plate, though constantly present, does not irritate equally at all times, but more (it is supposed) in dyspeptic or depressed states. The ulcer at first has the characteristics of a small spreading ulcer—sloughy or bright red base, sharp-cut low margins, more or less œdematous surroundings. It is irritable and painful. After weeks or months, the base becomes paler, the margins thicker and rounder, and more or less indefinite induration of the base appears. Naturally, the seat of these ulcers is almost invariably the edge or tip. In their diagnosis, the relation to an irritant, the absence of a history of syphilis or tubercle, the absence of cancerous induration, and the effect of removal of the cause and subsequent treatment, are the chief points.

Dyspeptic ulcers are apt to occur in ill-fed children, and also in adults who habitually eat and drink freely. Such ulcers are generally situated upon the sides or upper surface near the tip; but not infrequently they are on the frænum. They are encircled by an inflamed margin; shallow; their bases being flat and covered with a greyish slough. They are very sensitive to the touch, and painful when the organ is moved. Sometimes there is offensive discharge, with a good deal of swelling of the sublingual and submaxillary glands.

Treatment.—Defects of digestion must be attended to; a cholagogue purge is often a good beginning. The mouth should be kept scrupulously clean, and all sources of mechanical irritation removed. Honey of borax should be used frequently; and the ulcers painted with chromic acid solution (grs. v–x to ℥j) every two or three days.

Stanley Boyd.

TONIC (*τόνος*, tension).—A distinctive term used in reference to the nature of spasms, which are usually divided into two classes, namely, *tonic spasms* and *clonic spasms*; the former being those in which the muscles concerned remain in a state of continuous rather than in one of intermittent contraction or clonic spasm. *See* Spasm.

TONICS (*τόνος*, tension, tone).—Synon.: Fr. *Toniques*; Ger. *Tonische Mittel.*

Definition.—Therapeutic agents which impart permanent strength to the body or its parts.

Enumeration.—Amongst the most typical medicinal tonics, which impart a feeling of strength, are Iron, Nux Vomica, Quinine, and Vegetable Bitters. As the strength of the body generally depends on the proper action of its various parts, tonics have been subdivided into those which have an especial action on the blood-circulation, digestion, and nervous system.

1. **Blood Tonics.**—Cod-liver oil and other fats, and iron and its salts, are the most important of this group of tonic remedies. Perhaps also phosphate and hypophosphite of calcium, salts of potassium and sodium, arsenic, and phosphorus should be included. Light, fresh air, good food, bathing, and exercise are valuable adjuncts.

2. **Cardio-vascular Tonics.**—The principal vascular tonics are Nux Vomica and Strychnine, Digitalis, Strophanthus, Erythrophleum, Squill, and Caffeine. The local application of warmth and cold, friction, and massage increase the effect of these medicines.

3. **Gastric Tonics.**—Small doses of Sulphuric, Nitric, Hydrochloric, and Phosphoric Acids, small doses of Arsenic, Alum, Bismuth, Copper, Silver or Zinc, Aloes, Bitter Beer, Chamomile, Cinchona, Cusparia, Cascarilla, Calumba, Hops, Gentian, Orange and Lemon Peel, Quassia, Rhubarb, Strychnine, and Vegetable Bitters generally, all impart vigour to the gastric function. Valuable adjuncts are pepsin and hydrochloric acid.

4. **Intestinal Tonics.**—These are chiefly Nux Vomica, Belladonna, Rhubarb, the Mineral Acids and Metallic Salts just mentioned, and astringents.

5. **Nervine Tonics.**—Nux Vomica and Strychnine, Cinchona and its alkaloids, Coca, Phosphorus, Arsenic and its compounds, salts of Iron, Zinc, Copper, and Silver, are all included under this head. The tonics which act especially on other parts of the system increase also the power of the nervous system, and act indirectly as nervous tonics.

ACTION. — The derivation of the word 'tonics' indicates the nature of their action. When a person feels limp and weak, and unfit for exertion, like a relaxed bowstring, tonics restore the energy and strength, and render him again fit for work, like, as it were, a re-tightened bow. The exact mode in which tonics act is not yet perfectly ascertained, but in all probability they increase the functions of the different parts of the body by aiding tissue-change, either by increased nutrition, increased tissue-metabolism, more rapid removal of waste, or possibly by all three taken together.

USES.—Tonics are employed in conditions of debility, either of the body generally or of its different parts, the selection of each depending upon the part of the body affected.

In cases where the malnutrition of the body appears to be dependent on the want of the proper constituents of the blood, as in anæmia, struma, or general debility, without any affection of a particular organ, *blood tonics*, including iron, cod-liver oil, phosphates, and hypophosphites are employed; and these are also useful where impoverishment of the blood is due to a definite constitutional disease, such as phthisis, or Bright's disease. In pernicious anæmia phosphorus or arsenic may be used. Where enfeeblement of the stomach appears to be present, as shown by loss of appetite and such signs of imperfect digestion as flatulence, weight, and pain after eating, *gastric tonics* are used. Should its muscular coat be feeble or inactive, as shown by tendency to dilatation, and splashing of the contents on movement, strychnine is especially indicated, and galvanism or systematic kneading may be also employed. Where the stomach is too debilitated to respond sufficiently to this form of treatment, as after long-continued gastric catarrh, or in old age, its work must be partly done for it, and then such substances as hydrochloric acid and pepsin are useful. When the muscular movements of the intestine are sluggish, as indicated by constipation, and by a tendency to the distension of the bowel with gas, nux vomica and belladonna may be given; and when its mucous membrane appears to be relaxed and flabby, and secreting too profusely, the mineral acids, astringents, and metallic salts may be of much service. When the pulse is soft and feeble, and there is a tendency to vascular dilatation, either general or local, as shown by local congestion and œdema of dependent parts, or by drowsiness in the upright position and sleeplessness in the recumbent posture, *vascular tonics* are serviceable. *Nervine tonics* are used where the nervous functions are imperfectly performed, as shown by dulness, loss of memory, incapacity for work, languor, or tendency to spasm, as in chorea, and also in paralysis. As the functions of this system depend very greatly upon the quality of the blood with which the nervous system is supplied, and on the rapidity of the circulation, the other tonics frequently require to be given in addition to nervous tonics.

In administering tonics, care should always be taken to ascertain that the case is suitable, for in very many cases of apparent debility the imperfect functional activity of the body or of its parts does not depend upon insufficient nutrition, but upon imperfect removal of the products of waste. The proper treatment in these cases is not to give tonics, but to remove the waste products by cholagogues, purgatives, and diuretics. T. LAUDER BRUNTON.

TONSILS, Diseases of.—SYNON.: Fr. *Maladies des Amygdales*; Ger. *Krankheiten der Mandeln.*

The tonsils, situated between the anterior and posterior pillars of the fauces, are unusually liable to participate in all affections of the throat, both from their peculiar structure and from their position. Thus in that everyday affection, a common cold, the tonsils usually exhibit symptoms of the general catarrh. They are also involved in diphtheria, scarlet fever, and syphilis; they may be the seat of ulcers, or even gangrene; and they may be involved in malignant disease. The following affections demand special notice, namely: (1) Acute Inflammation; (2) Follicular Catarrh; (3) Hypertrophy; and (4) Tonsillar Calculus.

1. **Acute Inflammation.**—SYNON.: Acute Suppurative Tonsillitis; Quinsy; *Cynanche Tonsillaris*; *Amygdalitis.*

ÆTIOLOGY.—This affection is most commonly met with in young persons of rheumatic constitution, during the damp weather of spring and autumn; and one attack seems to predispose to another. Exposure to damp, cold, and wet is generally regarded as sufficient to excite this disorder.

SYMPTOMS. — Quinsy usually sets in with

fever. The patient becomes restless, irritable, and hot—the temperature in very acute cases rising to 104° or 105°; complains of headache and general weariness; and may become delirious at night, especially if he be young. The tongue is covered with a thick, heavy, yellowish coating; the other symptoms of oral catarrh are present; the breath is unpleasant; and salivation is complained of. The patient loses the power of opening the mouth to any extent; and swallowing is attended with much pain and great difficulty, the food not infrequently returning through the nose. The tone of the voice is altered, becoming thick, guttural, and nasal. The breathing is not, as a rule, impeded, but the patient snores during sleep; and when he is awake, respiration may be noisy. Occasionally he becomes deaf.

The first indication of uneasiness in the throat is a complaint of pricking and dryness in the region of the tonsil, soon passing on to actual soreness; and pain of a dull character, which shoots up towards the ear on the affected side. Externally, behind the angle of the lower jaw, considerable swelling is observed, which is firm, and exceedingly painful to touch. On examination of the parts internally, one tonsil, rarely both, will be found to be greatly swollen, of a deep red colour, perhaps with patches of yellowish secretion adherent to its surface. The soft palate is also greatly swollen, red, œdematous, and falling inwards to the middle of the mouth. The uvula likewise partakes of the general infiltration, and is usually found pushed to the healthy side, and not infrequently adherent to the tonsil.

Course.—This state of matters continues for four or five days, increasing in severity; then it may gradually begin to subside, the inflammation passing off. Usually in ten days to a fortnight the patient is able to resume his employment. Quite as frequent a termination as resolution is suppuration with formation of abscess in the tonsil. In such a case the symptoms are generally aggravated before the formation of the pus, and more decided pain and throbbing are complained of, extending upwards to the ear. The abscess may burst spontaneously and unexpectedly. After the evacuation of the pus, which is often fœtid, convalescence is speedy.

Treatment.—If a case of quinsy be seen at the very outset, an attempt may be made to abort the disease. This, though seldom successful, may be tried by giving an emetic, or by administering tincture of aconite every hour in drop doses; or by drachm doses of the ammoniated tincture of guaiacum, best given in milk; or by 15-grain doses of salol every three hours. Scarification of the tonsils may be tried, afterwards painting them with a fairly strong solution of cocaine. If not seen for two days, or if these abortive measures fail, the patient should be confined to bed; hot poultices or cold compresses kept constantly round the throat; steam inhaled as often as practicable; and gargles of warm milk and water made use of every hour. A brisk saline purgative should be given. Ice, if found grateful, may be allowed at discretion. Such diet as the patient can be persuaded to swallow should be ordered, of course in liquid or rather semi-solid form. This can be greatly facilitated by brushing or spraying the affected parts with a 4 to 8 per cent. solution of hydrochlorate of cocaine previous to offering the food. Stimulants, if called for, must be administered. Tonics, such as chlorate of potassium and iron, or quinine and iron, will be needed when convalescence sets in. If an abscess should form, it must be evacuated by means of a well-protected bistoury; and astringent gargles should be made use of for some time after convalescence is established.

2. **Follicular Catarrh.**—The office of the tonsils is to secrete a lubricating fluid to the bolus of food as it passes into the pharynx, as well as to moisten the fauces. Occasionally we meet with cases where this secretion is altered in character or in quantity. And this may be the result either of a simple catarrh of the tonsils; or of acute swelling of the interstitial tissue of the gland, compressing the follicles, and thus interfering with the free outflow of the secretion. The appearance of the inflamed tonsil in such a condition is at times mistaken for diphtheria, in consequence of the whitish patches of secretion deposited upon them. In this catarrhal affection it will be observed that there is no tendency to the formation of a true membrane as in diphtheria. The deposit assumes a pultaceous form, is readily removed, its borders are well-defined, and it is seen to proceed from the follicles of the tonsil. Occasionally this affection appears to be contagious, and to attack one member of a family after another. In such case examination of the contents of the crypts of the tonsils has revealed the presence of the Staphylococcus or Streptococcus pyogenes, which is probably the infectious organism. The symptoms include fever, with considerable pyrexia in children; local pain; and dysphagia.

Treatment.—The parts should be brushed with equal parts of boroglyceride and glycerine, after cleansing the throat with a warm solution of salicylate of sodium, 20 grains to the ounce of water. Internally 10-grain doses of benzoate of sodium may be given every hour and a-half. The patient should also cautiously suck compressed tabloids of chlorate of potassium and borax, or 5-grain tabloids of salol. Some iron tonic will probably be called for later.

3. **Hypertrophy.**—This condition of the tonsils is met with both in the young and in

the adult. In the former, there seems to be an hereditary tendency in some families, the tonsils becoming immensely large even as early as the second year. In such there is occasionally some scrofulous habit of body. In the adult this condition is more frequently the result of repeated angina, which induces a permanent thickening of the tissues of the tonsils, whereby the secretion, no longer finding free exit, distends the follicles, thus setting up a low form of inflammation, which results in hypertrophy of the gland. This condition is free from pain. When the interstitial tissue becomes much thickened and indurated, there occurs what is sometimes described as 'scirrhus' of the tonsil. The symptoms indicative of hypertrophy are snoring during sleep; obstruction to the breathing, in consequence of which the mouth is always open night and day; slight impediment to swallowing, with a sense of something permanently needing to be swallowed; some degree of deafness; and thickness of voice or snuffling. These are all greatly aggravated when catarrh is superadded; and persons having enlarged tonsils are specially liable to attacks of acute inflammation, and to severe throat-symptoms, when any disorder overtakes them, in which the throat is more than ordinarily the point where the disease centres itself, for example, scarlet fever.

TREATMENT.—The treatment of enlarged tonsils in scrofulous children consists in plentiful nourishment, cod-liver oil, iodide of iron, and other drugs of which iodine forms the chief constituent. The bromides of ammonium and potassium also enjoy the reputation of reducing enlarged tonsils. Locally, they should be treated with iodine dissolved in glycerine, or with the simple tincture, every other day. Bicarbonate of sodium applied locally is occasionally useful. They should not be removed in children under the age of puberty, as frequently after that period they decrease spontaneously. In adults, if they cause much inconvenience, they should be excised or treated by ignipuncture, the thermo-cautery being thrust into each crypt. In this way all risk of hæmorrhage is obviated.

4. **Tonsillar Calculus.**—When two or three neighbouring follicles of a tonsil, as well as the interstitial tissue, are destroyed, the cavity thereby created pours out a greatly altered secretion, the product varying in consistence from a creamy pulp up to a calcareous deposit, of a white or yellow colour. This, on examination, has been found to consist of the phosphate, carbonate, and oxalate of calcium, albumin, and other animal matter. Some authors regard these calculi as the 'resolution of tuberculous deposits in the tonsils, which subsequently give rise to inflammation, suppuration, and ejection.'

CLAUD MUIRHEAD.

TOOTHACHE.—SYNON.: Fr. *Odontalgie*; *Mal de Dents*; Ger. *Zahnweh.*—Pain in connexion with the teeth. *See* TEETH, Diseases of.

TOOTH-RASH.—*See* DENTITION, Disorders of.

TOPHUS (*tophus*, sand).—A term associated with the concretions, consisting chiefly of sodium biurate, which are met with in gout, in connexion with the joints and other structures. It is also sometimes applied to gravel in the urine, and to the collection of tartar on the teeth. *See* GOUT.

TOPICAL (*τόπος*, a place).—*See* LOCAL.

TORMINA (Lat. griping).—This word is applied to severe griping or colicky pains in the abdomen, due to flatus and other causes. *See* COLIC; COLIC, INTESTINAL; DYSENTERY; and INTESTINES, Diseases of.

TORPOR (Lat. numbness). — SYNON.: Fr. *Torpeur*; Ger. *Torpidität.*—A condition of inactivity, bodily and mental, which may be met with in certain cerebral diseases or febrile states, more especially in aged persons. The cerebral condition associated with torpor is an unnatural state of consciousness, closely allied to that known as stupor. *See* CONSCIOUSNESS, Disorders of.

TORQUAY, in South Devonshire.—A mild, rather relaxing, and sedative marine climate. Sheltered from W., N., and E. winds. Mean winter temperature 44° F. *See* CLIMATE, Treatment of Disease by.

TORSION (*torqueo*, I twist). — This word signifies a twisting, and is used in medical literature in the following associations:—

1. In relation to certain organs or growths, it indicates a form of displacement in which the mass is twisted on itself, a condition especially noticed in connexion with the intestines. It gives rise to more or less narrowing of canals, and may close them completely, so as to cause absolute obstruction. Torsion also interferes with the local circulation, thus leading to congestion, inflammation, or ultimately even to gangrene of organs or tumours. *See* INTESTINAL OBSTRUCTION.

2. As a method of treatment, torsion is employed in checking arterial hæmorrhage, the ends of the bleeding artery being seized by the aid of suitable forceps, and twisted. It is chiefly used in bleeding from small arteries, but may prove efficient even when arteries of some size are the source of the hæmorrhage.

FREDERICK T. ROBERTS.

TORTICOLLIS (*tortum*, twisted; and *collum*, the neck).—A synonym for wry-neck. *See* WRY-NECK.

TORULA.—Description.—Torula is a form of microscopic fungus, belonging to the group *Saccharomycetes.* It consists of round or ovoid cells, of an average diameter of about $\frac{1}{3000}$ inch, without nuclei, but composed of masses of vacuolated protoplasm, confined within a definite cell-wall. Occasionally they are free, but they are frequently associated into branching chains. *See* Microscope in Medicine.

Vinous, acetous, and other fermentations are due to the presence of organisms, of which the 'yeast plant,' *Mycoderma* or *Torula cerevisiæ,* is the best known. Certain varieties of torula are of constant occurrence in the alimentary canal, and would seem to be normally associated with intestinal digestion. In those cases of vomiting where the ejected matters ferment, torulæ are always to be found, together with sarcinæ. These bodies are also of frequent occurrence in the urine of diabetes mellitus, if left standing; but they have likewise been found in non-saccharine urine. The pathological significance of torula, if any, is not known.

W. H. Allchin.

TOUCH, Disorders of.—Synon.: Fr. *Troubles du Tact*; Ger. *Störungen des Tastsinnes.*—The sense of touch may be considered as a compound of four distinct senses, namely, those of contact, pain, temperature, and muscular activity; and it is not necessary that all of these should be affected simultaneously or in an equal degree. Sometimes but one is the seat of disorder, and occasionally only one escapes. The lesion producing tactile disorder may be in any part of the sensory apparatus—in the peripheral end-organ in the skin, which receives impressions, in the trunk of the nerve which conveys them, or in the central ganglion, the reaction in which is represented in consciousness as feeling. For the most part disorders of touch must consist either in a defective or in an unnaturally heightened reaction to impressions—conditions which are termed respectively *anæsthesia* and *hyperæsthesia.* But there are besides certain abnormalities of sensation which cannot be referred to either of these categories, as, for example, when a touch causes a sensation of burning, or the electric current is felt as something cold, and in these circumstances the term *paræsthesia* is used.

1. Increased Sensibility. — Description.—It is doubtful whether the sense of touch proper, the power of tactile discrimination, is ever morbidly *increased,* except possibly in certain cases of hysteria and mental disorder. The term *hyperæsthesia* would be properly applied to such a condition instead of, as it is more commonly used, to excess of sensibility to painful impressions, which is perhaps better called *hyperalgesia.* In cutaneous *hyperalgesia* even a light touch upon the skin produces more or less exquisite pain. The patient often cannot even wash the skin, which is described as feeling raw or sore to the touch. The symptom frequently occurs in connexion with neuralgia (especially of the trigeminal nerve), and in hysteria, as well as in the various forms of local inflammation. It may precede by some days the characteristic pains of neuralgia; is often associated with excess of sensibility to heat and cold; and usually with diminution of sensibility of the tactile sense proper. It is seen in its severest form in connexion with gunshot injuries of nerves.

There may be heightened sensibility to *temperature,* either as regards heat or cold singly, or in respect to both at the same time. This symptom is observed in connexion both with peripheral and central disease—as an accompaniment of neuritis, as well as of degenerative changes in the cord or cerebral ganglia. It is often, but not always, associated with *hyperalgesia.*

Heightening of the sense of *contact* is rarely observed, and is of but little practical importance. Perhaps the condition known as 'fidgets' is best explained as depending upon a heightened sense of *muscular activity.*

Treatment.—So far as is practicable, the lesion which is the cause of hyperalgesia, whether peripheral or central, must be discovered and become the subject of treatment. But the symptom itself may be mitigated by appropriate means. Such are the local application of moist heat by fomentation or poultice; of cold, by means of ice; or of anodynes, such as veratrine ointment somewhat diluted, or atropine ointment; or the hypodermic injection of morphine (gr. $\frac{1}{10}$ to gr. $\frac{1}{6}$). Spongiopiline may be sprinkled with a liniment composed of chloroform one part and belladonna liniment three parts; or equal parts of ether, sal volatile, laudanum, and eau de Cologne may be applied. A piece of lint soaked in chloroform may be laid upon the painful portion of skin and covered with oiled silk, or the part may be rubbed with camphor-chloral and vaseline, equal parts; or painted with amyl-colloid. The application of one pole of the continuous current to the hyperalgesic spots, whilst the other is placed on an indifferent part, will often be of service, the power of bearing a gradually increased strength showing the improvement produced. Hysterical hyperalgesia can sometimes be successfully treated by the application of a strong induced current, by means of the wire brush, the patient, if necessary, being placed under the influence of ether.

2. Defective Sensibility. — Description.—Cutaneous anæsthesia may result from local abstraction of heat, as from exposure to a very low temperature. In such a case anæmia is produced, from spastic contraction of blood-vessels, followed by hyperæmia from their secondary relaxation. In the anæmic stage, whilst the other tactile sensations are lowered, that of temperature is heightened. Deficient sensibility may be caused by irritating applications, such as soda used by laundresses, and various chemicals employed in the arts. In such cases there is numbness in the hands and forearms, with a sensation of 'going to sleep' in the fingers. It may occur in connexion with *herpes zoster*, the skin between the groups of vesicles being often partially anæsthetic. In *lepra anæsthetica*, in which there are enlargements of the cutaneous nerves, the senses of temperature and pain are often abolished, and severe burns may take place without being recognised. Anæsthesia may be produced by pressure upon sensory or mixed nerves, by syphilitic and other growths in adjacent tissues. Narcotics, as chloroform and ether, may quell the sense of pain, that of contact being, to a certain extent, retained. Wounds and lacerations of the sensory or mixed nerves, followed by inflammatory processes, may, by irritating, cause pain to precede the anæsthesia arising from the interruption of conductivity in the nerve-fibres. Simple mechanical pressure upon a nerve, if long continued, will often, especially if its nutrition be impaired by constitutional causes, excite a low inflammatory condition. In traumatic cases, as also in lepra anæsthetica and in cases of new-growths pressing on the nerve, motor and nutritive disturbances are apt to accompany the anæsthesia, the nerve-trunks conveying not only sensory, but also motor, vaso-motor, and trophic fibres. Severe trophic disorder is usually associated with the anæsthesia occasioned by lesion of the fifth nerve; and to a less extent with that accompanying trigeminal neuralgia. *See* Fifth Nerve, Diseases of.

Preceding attacks of neuralgia, the skin of the part about to be affected is often found to be anæsthetic, and during attacks of sciatica and cervico-brachial neuralgia there is often much diminution of tactile sensibility, severally in the foot and lower part of the leg, and in the fingers; whilst the skin around the eye may be greatly deficient in tactile sensibility during severe supra-orbital neuralgia. It is important to discriminate anæsthesia of the skin caused by diseases of the nervous centres from that which is of peripheral origin.

Cutaneous anæsthesia is occasionally an important symptom of an approaching cerebral hæmorrhage. A sudden and increasing numbness is experienced in one half of the face, or in the limbs on one side of the body, which may be followed shortly by hemiplegia and coma. An apoplectic seizure usually causes unilateral cutaneous anæsthesia, which is at first widely diffused, owing probably to the disturbance of circulation in, and consequent disarrangement of, the nervous molecules, which extends at first far beyond the site of the effusion. A few hours or days usually suffice for the clearing off of this anæsthesia, leaving, however, a subjective feeling of numbness, which may endure for a longer or shorter period.

The extent of anæsthesia bears no necessary relation to the amount of motor paralysis. It usually affects the paralysed side of the body, but in certain cases of hæmorrhage into or other lesion of the medulla oblongata and pons Varolii, it may occupy the opposite side. Complete hemi-anæsthesia of central origin may persist long after the paralysis of motion has disappeared, and in such a case a lesion is likely to be found in the outside of the optic thalamus, involving the internal capsule. Occasionally, too, hemi-anæsthesia may from the first be unaccompanied by motor paralysis. Much more frequently, however, cutaneous anæsthesia (except for the first few hours) is of comparatively slight and transitory character, even in cases where there has been extensive disorganisation of the brain from hæmorrhage or softening, and where the resulting paralysis of the muscles is complete and permanent. Recovery is gradual, and proceeds downwards, the fingers sometimes retaining slight anæsthesia long after the rest of the arm has entirely recovered.

Cerebral tumours may give rise to cutaneous anæsthesia by pressure upon the Gasserian ganglion, or upon the trunk or branches of the fifth nerve as they traverse the floor of the skull. Like the motor paresis or paralysis which may be occasioned at the same time, the loss of sensibility is usually, but not always, gradual, tending to increase rather than to diminish as time goes on. It is not usually a prominent symptom in cerebral abscess.

Lesion of the spinal cord or its membranes may give rise to cutaneous anæsthesia, which is frequently, in the lower extremities, extensive and complete; but it may be absent when—as, for example, in very advanced sclerosis of the antero-lateral columns—there is complete paraplegia. There is a form of progressive disease of the central and posterior grey matter of the spinal cord, giving rise to excavation, in which cutaneous sensibility is apt to be modified in a remarkable manner. The sense of touch, the sense of pressure, as well as the electro-muscular sensibility and the muscular sense, are preserved; but the appreciation of temperature and the sensation of pain (one or both) are lost in many situations. The condition is accompanied by paralysis and various forms of nutritional disturbances (*see* Spinal Cord, Special Diseases of: 21. Syringomyelia). A varying amount of cutaneous anæsthesia, especially affecting the soles of the feet, is apt to occur in tabes. Anæsthesia of spinal origin is usually bilateral; but it is believed to affect that lower extremity alone which is opposite to the one paralysed in its motility, when the causative lesion is limited to one half of the cord. Intercurrent complications from disturbances of circulation, the temperature of the limb, the extension or subsidence of inflammation, and the effusion of inflammatory products about the posterior roots, as well as the spread of sclerotic changes, may cause the extent and completeness of cutaneous anæsthesia to vary considerably in cases dependent upon spinal-cord disease. Where the lesion lies tolerably high up, tickling the soles of the feet, although quite unfelt by the patient, is able to excite the motor nerves, and produce reflex muscular contractions, which the loss of muscular sense prevents him from recognising. It is extremely important to remember that cutaneous anæsthesia of spinal origin is liable to be associated with bedsores. In certain cases, where probably trophic and vaso-motor nerves have been included in the lesion, this liability is excessive, and may defy all precautions.

Anæsthesia is of very frequent occurrence as a result of peripheral neuritis, both in its localised and multiple form. *See* Neuritis, Multiple.

Loss of the *sense of muscular activity* may occur in an isolated form, the other modes of tactile sensibility being unaffected; or it may be associated with impairment of some or all of them. The symptom is especially notable in progressive locomotor ataxy (*see* Tabes Dorsalis). It may also occur in connexion with paresis resulting from coarse disease of the occipital lobe of the cerebrum. Loss of muscular sense may accompany hemiplegia, attended with strongly marked and prolonged anæsthesia, from disease of the optic thalamus. It occurs sometimes in hysteria. There is a form of anæsthesia occasionally met with in hysteria which it is important to recognise, so as not to confound it with a somewhat similar condition resulting from disease of the neighbourhood of the optic thalamus. In this the patient may lose the power of perceiving impressions of contact, temperature, and pain throughout the whole of one lateral half of the body, sharply divided from the sound side by a line passing downwards from the vertex to the os pubis. Accompanying this *hemianæsthesia*, as it is called, there is often amblyopia and colour-blindness of the corresponding eye, loss of taste and smell, together with tenderness on deep pressure over the region of the ovary on the same side. In some cases, too, the skin is unnaturally pale and cold, and pricks with a pin are said to be not followed by bleeding, which readily takes place in corresponding circumstances on the opposite side of the body.

There is a curious form of disturbance of tactile sensation in which, the patient being blindfolded, a point of contact is referred not to its true locality, but either to some part of the opposite limb, or to a distant part of the same member. *See* Allochiria.

Diagnosis.—As regards both hyperæsthesia and anæsthesia the most important consideration, after establishing the existence of either, is as to whether the cause be central or peripheral. It is impossible to do more than indicate the general principles upon which this inquiry is to be conducted. The patient's history, the condition of viscera and circulation, the existence or not of accompanying paralysis or of modifications of the organs of special sense, will lend important aid. As a rule, the anæsthesia of central origin is much more widely diffused, though less complete, than that dependent upon lesion of nerve-trunks, when it is also often accompanied with localised atrophy of muscles or other trophic disturbance. It is very rare that hemianæsthesia of central origin is so complete as the hysterical, and it is not accompanied, like the latter, with tenderness on deep pressure over the ovarian region. There is no doubt that hyperæsthesia has often been mistaken for localised inflammation, and treated accordingly. The absence of febrile movement, and the fact that it is mainly upon light surface-touching that the exquisite tenderness occurs, which fails to be felt when deeper pressure is made, coupled with the history, and a study of the concomitant condition, ought to suffice to prevent all mistakes.

Treatment.—Anæsthesia is a symptom of a lesion either in the central nervous system or in a peripheral nerve, and its treatment is bound up with that of the disorder which gives rise to it. But there are many cases in which, apparently as a result of disease, the sensory nerves fail to convey impressions for a considerable time after the lesion which interfered with their function has been healed. In such circumstances very much good can often be done by electrical treatment. The skin, carefully dried, should be brushed over for a few minutes every day with the wire brush, connected with an induction machine; or the well-wetted rheophore connected with the negative pole of a continuous-current battery may be slid about over the affected surface, well moistened with hot water.

Static electricity is a valuable means of combating anæsthesia of this kind. The patient, seated on an insulating chair, is connected by a conducting chain with a frictional electrical machine, and sparks are drawn from the affected surface.

3. **Paræsthesia.** — Description. — The varieties in disorder of the different kinds of tactile sensibility—touch, pain, temperature, muscular activity—are very numerous. Pinches or pricks with a needle may be felt as touch only, whilst a very light touch with the finger is appreciated as touch. Strong faradic currents (intolerable to the healthy) may be felt as cold. Heat may be felt as

cold, but kept still longer applied may be recognised as heat or warmth. A limb plunged into hot or cold water may get the feeling, not of heat or cold, but of pain. To such modifications, as well as to feelings of burning or cold, tingling, creeping of ants, or actual numbness, the term *paræsthesia* is often applied. A seamstress may be able to pick up and thread her needle, evincing thereby considerable delicacy of sense of contact, and yet be scarcely able to feel a prick of a needle in the finger-tip. Or the sense of contact may be in abeyance, as well as that of pain and temperature, and the movements may be then guided by the sense of muscular activity, aided by sight. T. BUZZARD.

TOXÆMIA (*τοξικόν*, a poison; and *αἷμα*, blood).—This word literally signifies poisoning of the blood. It is not employed with any very strict or definite meaning, but most commonly implies blood-poisoning due to some pathological condition within the body itself, in contradistinction to that which results from the introduction of the ordinary poisons from without. As illustrations of toxæmic states may be mentioned pyæmia and septicæmia; uræmia; and acetonæmia, upon which, according to some authorities, the comatose condition which precedes the fatal issue in some cases of diabetes mellitus depends. The accumulation of bile in the blood, in cases of jaundice, is another form of toxæmia. The morbific agents which produce the several infectious and malarial fevers are regarded by many as originating toxæmic conditions; as are also those which cause such affections as gout and rheumatism. Ptomaïne-poisoning may be likewise mentioned in this connexion. These subjects will be found discussed under their several headings.

FREDERICK T. ROBERTS.

TRACHEA, Diseases of.—SYNON.: Fr. *Maladies de la Trachée*; Ger. *Krankheiten der Luftröhre.*—The trachea is but little prone to disease, except in association with affections of the larynx, bronchi, and neighbouring parts. The diagnosis and treatment of these several diseases is greatly facilitated by the laryngoscope. With this instrument a skilful manipulator can in many cases examine the trachea in its whole length; and an accurate diagnosis being thus attained, remedies may be applied, and instruments may be introduced for the removal or destruction of growths, or for other purposes, either through the larynx, or by an artificial opening made in the trachea. The principal morbid affections of the trachea will be discussed in the following order: (1) Malformations; (2) Inflammation; (3) Ulceration and Perforation; (4) Syphilis; (5) Tuberculosis; (6) Tumours; (7) Stenosis; and (8) Foreign Bodies.

1. **Malformations.**—Defects in the development of the trachea occur as rare causes of the death of newly born infants. The tube may be short and imperforate; or communication may exist with the œsophagus. These conditions are necessarily fatal. A fistulous opening through the skin occasionally occurs, giving rise to no serious symptoms. *Tracheocele*, a hernia of the mucous lining of the trachea, is a rare malformation, easily recognised, which may arise from a congenital defect, but is more frequently acquired.

2. **Inflammation.**—Tracheitis—simple, specific, or diphtheritic—may result from the extension of inflammation, either from the larynx above, or from the bronchial tubes below; it is rare except in this connexion. Some degree of congestion is a usual condition of ordinary catarrh; and tracheitis is a frequent cause of irritable cough. *See* BRONCHI, Diseases of; DIPHTHERIA; and LARYNX, Diseases of.

3. **Ulceration and Perforation.**—Ulceration and perforation of the walls of the trachea may result from carcinoma of the œsophagus; from the pressure of an aneurysm, which ends by bursting into the air-passages, where it meets with least resistance; or from an abscess which has taken a similar course. In the last case suppuration usually occurs in connexion with a caseous bronchial gland. Occasionally, as witnessed by more than one writer, a caseous gland may become dislodged and impacted in the trachea, causing sudden death by suffocation.

4. **Syphilis.**—Syphilis, in its secondary and tertiary stages, may affect the trachea. In the tertiary stage it gives rise to a localised form of infiltration or syphiloma; and to ulcers, which contract in healing, and cause a formidable condition of stricture, to be presently considered. Tracheal syphilis, being in its advanced form so grave a matter, calls for active constitutional treatment before this irremediable stage is reached.

5. **Tuberculosis.**—Tubercle affecting the trachea occurs in connexion with pulmonary phthisis, and is rarely found without advanced tubercular disease of the larynx. Two main forms may be distinguished, namely—multiple shallow ulcers, which often coalesce to form large sinuous tracts of ulceration, mostly affecting the cartilaginous portion; and deep infiltration and ulceration, confined to the posterior or membranous part of the tube. When the disease has proceeded to ulceration, it may cause the rare complication of general emphysema, the air being forced into the cellular tissue by cough and other expiratory efforts, made when the larynx is closed. In the treatment of this affection, palliative measures are alone available. *See* LARYNX, Diseases of: 8. Tuberculosis of.

6. **Tumours.**—(*a*) *Cancer.*—Primary carcinoma of the trachea is very rare, but the organ is frequently affected by the extension of the disease from neighbouring parts. The growth first causes the symptoms of stenosis, and then, as ulceration proceeds, it gives rise to expectoration and cough; whereas, as Gerhardt has pointed out, in syphilitic disease cough and expectoration precede the onset of dyspnœa, which develops very gradually. The diagnosis may be very difficult in the primary form, and can only be made with the aid of the laryngoscope. In the case of extension from neighbouring parts the diagnosis is comparatively easy. The only treatment available for prolonging life is tracheotomy, if the seat of the disease is high enough to admit of it. (*b*) *Non-malignant growths.*—Polypi are very rare. The symptoms are those of obstructed breathing, modified by the size and seat of the growth. A certain diagnosis can be attained only by tracheoscopy. Without treatment, a polypus is very likely to cause death by suffocation, its rate of growth depending on its pathological nature. Small growths situated high up may be treated by the galvano-cautery or by other applications through the larynx; larger tumours can only be removed through a free opening made into the trachea. A tumour may be so situated that tracheotomy, without extirpation, may ensure the safety of the patient.

7. **Stenosis.**—The calibre of the trachea may be lessened (*a*) by *stricture*, or by *tumours growing within it*; or (*b*) by *pressure from without*.

(*a*) *Stenosis from true stricture, or internal tumour.*—Tracheal stricture is almost always the result of syphilis; it may be annular and limited, but usually involves the tube for some length towards its lower end, and frequently extends into the bronchi. Tracheal narrowing is indicated by inspiratory stridor and dyspnœa, unaccompanied by the up-and-down movement of the larynx, and the affection of the voice characteristic of laryngeal dyspnœa, and also in uncomplicated cases without the stethoscopic signs of pressure on, or plugging of, a bronchial tube. Under these circumstances, and in the absence of any tumour in the neck or thorax pressing on the trachea, the stenosis must depend on a stricture, or on a tumour within the tube. A syphilitic history would lead us to suspect the former; and a tracheoscopic examination may make the diagnosis certain.

Cicatricial stricture at times develops in consequence of the long-continued irritation of a tracheotomy tube.

In rare instances stenosis of the trachea may result from a chronic form of tuberculosis resembling lupus, leprosy, glanders, and rhinoscleroma.

Symptoms of stenosis are occasionally evoked by spasm of the trachealis muscle.

Prognosis.—Stricture being usually cicatricial, the prognosis is most unfavourable.

Treatment.—Treatment other than operative is seldom available. If the stricture be high up, tracheotomy must be performed below it; or, an opening being made above the contraction, a long flexible tube may be introduced and passed through it. Stricture of the trachea is less amenable than laryngeal stenosis to treatment by mechanical dilatation with hollow bougies, but this method must be borne in mind for exceptional cases.

(*b*) *Stenosis from compression.*—The source of stenosis caused by pressure from without is usually obvious, as in the common case of enlargement of the thyroid gland, thoracic tumours being diagnosed by their physical signs and concomitant symptoms. The paroxysmal dyspnœa frequently caused by these tumours is not laryngeal in most cases, but depends, as shown by Bristowe, on the accumulation of secretion below the seat of obstruction. It is not relieved by tracheotomy, except where the upper part of the trachea is alone compressed. In cases of stenosis from pressure of a goître, division of the isthmus or excision of part of the thyroid gland is sometimes very successful, and should always be tried, if possible, before tracheotomy is resorted to.

8. **Foreign Bodies.**—A foreign body entering the air-passages from the pharynx, may lodge in the larynx, either becoming impacted or lying loose. But, unless prevented by its form or bulk, it usually falls or is drawn through the open glottis into the trachea. Here it may lodge; but it more frequently passes on into one of the bronchial divisions—most frequently into the right bronchus, the orifice of which is slightly larger than that of the left, and occupies more of the floor of the trachea.

Symptoms.—Occlusion of the larynx by a foreign body, which from its bulk obstructs the passage, may cause instant death; and the same may be said of the trachea, as when a person vomiting, in a state of unconsciousness from intoxication, or from the action of an anæsthetic, draws in a quantity of food sufficient to choke up the air-passages. If the body be smaller, it causes dyspnœa, with severe exacerbations from spasm. A very small body, such as a sharp piece of bone or a pin, may be impacted in a position in which it causes only pain and dysphagia without dyspnœa. Speaking generally, it may be said that when the substance has passed into the trachea, the symptoms to which it gives rise depend on its bulk and weight. Rarely, it lies in the air-passage, giving rise to no symptoms; more frequently, varying its position with the rush of air in coughing, &c., it gives rise to paroxysmal dyspnœa, light bodies being forced up to the glottis and exciting spasm.

If the substance pass into the bronchus, it may become impacted there, and will give rise to characteristic physical signs, usually exciting a chronic circumscribed inflammation, with symptoms akin to pulmonary phthisis.

Treatment.—From the larynx a foreign body may be removed by the finger or a suitable forceps, its presence having been determined from the symptoms, aided by digital or laryngoscopic examination. Although different forms of long forceps are made for passing through the larynx into the trachea, it is seldom practicable to remove *per vias naturales* a foreign body which has once passed through the rima. A free opening must be made in the trachea, and its edges held well asunder, to give a chance of the body being expelled by cough. If this fail, a forceps must be introduced through the opening, and the body, if possible, extracted. Inversion of the patient, so as to allow a heavy substance to fall back through the glottis into the pharynx, is sometimes successful, but not as a rule without previous tracheotomy.

T. J. Walker.
Percy Kidd.

TRANCE (*transitus*, a going beyond—of the soul from the body).—Synon.: Lethargy; Fr. *Léthargie*; *Maladie du Sommeil*; Ger. *Schlafsucht*.

Definition.—A sleep-like state, which comes on spontaneously, apart from any gross lesion of the brain or toxic cause, and from which the sleeper cannot be roused.

The term 'trance,' in its derivative meaning, aptly expresses the apparent reduction to a vegetative life, but the popular use of the word refers rather to the separate activity of the mind than to the inactivity of the body. Hence many writers prefer the term 'lethargy,' which also, although etymologically exact, is currently employed in a modified sense. The condition is sometimes included under the generic term 'catalepsy,' according to its etymological meaning, 'a seizing'; but this term is usually restricted to those forms which present a peculiar rigidity. It may be noted that the terms 'trance' and 'catalepsy' are both indications of the unperceived shadow of a mythical pathology.

The common form of trance (which is not frequent) is one of many symptoms of a general state of the nervous system, seldom dangerous to life. In the African malady, the tendency to sleep is the chief manifestation of a disease, the gravity of which is extreme.

1. Common Trance.—Ætiology.—The influence of heredity in relation to trance is to be traced only in the existence of a 'neuropathic disposition.' The state occurs chiefly in the female sex, between the ages of twelve and thirty; very rarely in young men or children. The subjects are seldom in perfect health; they usually present various manifestations of hysteria, and are often anæmic. The condition has been immediately due in some cases to exhausting diseases, as typhoid fever and influenza, to excessive brain-work, to insolation, or to mechanical obstruction to the supply of blood to the head. The immediate cause is either the cumulative effect of such persistent influence, such exhaustion, or some emotional disturbance. It may succeed an hysterical convulsion. Rarely no exciting cause may be discoverable. In still more rare instances the state has been voluntarily induced, as in the well-known case of Colonel Townsend, who could throw himself into a condition of apparent death, lasting several hours. Such voluntary induction is occasionally seen in the East. Lastly, minor degrees of trance may, without difficulty, be artificially produced in most hysterical persons, and less readily in many others, by the methods described in the article on Hypnotism. The state now designated hypnotism is really induced trance, and trance has been accurately termed 'spontaneous hypnotism.'

Its various causes seem thus to involve impaired or deranged nutrition, or the action of a toxic agent (as after acute specific diseases), or an influence that disturbs function in an ill-nourished brain.

Symptoms.—The onset of the state of trance is usually sudden. For instance, in a case which came under the writer's notice, a girl went into a room by herself, and was found, shortly afterwards, in a state of trance-sleep, which lasted for thirty-eight hours. In another case (Madden) a young lady went into a room to change her dress, and was presently found on the bed in a state of trance which lasted for a fortnight. As already stated, it may succeed an hysteroid convulsion, and in some other cases the onset has been attended with an aura, resembling the globus hystericus. In the cases which succeeded typhoid fever (Madden) the delirium of the fever passed gradually into comatose sleep, which continued for several weeks. At the end of the acute stage of influenza spontaneous trance has suddenly come on, lasting hours or days.

During the state of trance, the countenance is usually extremely pale. The limbs are relaxed; although brief initial rigidity, and sometimes occasional recurrent cataleptic rigidity, or transient convulsive spasms, tonic or clonic, have been noted. In a few instances distinct hysteroid fits have occurred from time to time during the course of the trance. The eyelids are usually closed, and may resist and quiver on attempts being made to open them. The eyeballs are directed upwards in most cases; they often deviate from the middle line, and sometimes diverge slightly.

The pupils are usually moderately dilated; rarely they are moderately contracted. The state of reflex action varies according to the depth of the trance. That from the limbs is sometimes excessive, so that cutaneous stimulation produces tetanic rigidity. Much more frequently reflex action is lost; snuff blown into the nostrils causes no sneezing, ovarian compression has no effect, and pressure on hysterogenic points, which may have existed before, no longer causes the usual phenomena. Reflex action from the conjunctiva, and even from the cornea, is commonly absent. The pupil may contract to light, but in lessened degree, and sometimes no distinct action can be observed.

The mental functions seem, in most cases, to be in complete abeyance. No manifestation of consciousness can be observed, or elicited by the most powerful cutaneous stimulation, and on recovery no recollection of the state is preserved. But in some cases volition only is lost, and the patient is aware of all that passes, although unable to give the slightest evidence of consciousness. The senses may be even preternaturally acute, as in the analogous phase of induced hypnotism; or there may be spontaneous mental action, irrelevant to external impressions, and analogous to, probably identical with, the state of ordinary dreaming; it is manifested by exclamations, and even by movements. Rarely the 'obedient automatism' seen in induced hypnotism may be present; hallucinations occur, and actions are performed, according to suggestions made to the patient. The usual condition, however, is that of an entire absence of all evidence of mental activity.

The pallor of the face is the result of a profound depression of the vascular system. The pulse may be less frequent or more frequent than normal, but it is invariably weaker, and it may be imperceptible. The cardiac impulse may disappear, although the heart-sounds are still to be heard, sometimes much weakened. Very rarely they have been inaudible. The breathing may be tranquil, slightly quickened, or slowed, or it may be so feeble and deliberate that no movement of the thoracic walls can be observed, no respiratory murmur can be heard in the lungs, and a mirror held over the mouth is undimmed by moisture. Temperature, when observed, has been normal in the central parts, lowered at the periphery. The secretions go on; the urine may be retained in the bladder, or passed into the bed. The catamenia are usually absent, but menstruation has been known to occur without modifying the course of the trance-sleep. In the cases in which the depression of the vital functions reaches an extreme degree, the patient appears dead to casual and sometimes to careful observation. This condition has been termed 'death-trance' (*Scheintod*). Persons have certainly been buried in this state, and during the recent epidemic of influenza an Italian narrowly escaped interment during the consequent trance.

Duration and Course.—The duration of trance has varied from a few hours or days, to several weeks, months, or even a year. When of short duration, the trance-sleep may be unbroken; but when it lasts for more than a few days, there are usually remissions of a greater or less degree, in which, for instance, the patient will half-wake, take food in an automatic manner, and then relapse into stupor. A long trance-sleep may be more profound at first than later. Recovery may be sudden or gradual. Occasionally it is attended by some vaso-motor disturbance; in a well-authenticated case of death-trance the intense mental excitement produced by the preparations for fastening the coffin-lid occasioned a sweat to break out over the body. After the trance is over, nervous prostration remains for a time. In some cases repeated attacks occur, at intervals of days, months, or years. Most cases end favourably. The depression of the vital functions enables life to continue with a very small amount of nourishment, but occasionally death occurs in persons previously weakened.

Pathology.—The very few *post-mortem* examinations which have been made after death in trance, throw no light on its nature. The theoretical pathology of the subject is involved in the obscurity which envelops all the psychical processes in health and disease, the nature of volition, and ordinary sleep. The lowered action of the brain in sleep, and its lessened blood-supply, have suggested the existence of cerebral anæmia, which the meagre results of anatomical investigation have been supposed to confirm. It is certain that the condition is sometimes associated with defective cerebral nutrition; but that much more than cerebral anæmia is needed to explain the state of trance is evident from the facts that, on the one hand, it may occur when there is no preceding sign of defective blood-supply to the brain, while, on the other hand, the occurrence of cerebral anæmia without trance-sleep is a matter of daily observation. The phenomena of hypnotism also afford little support to the theory of the dependence of trance-sleep on cerebral anæmia; together with the symptoms of catalepsy, they suggest that the primary element is a peculiar state of inaction ('inhibition,' 'increased resistance') of some of the nerve-cells concerned in associating the highest cerebral functions with those of the lower cortical centres of motion and sensation.

Diagnosis.—The diagnosis of trance rests on the impossibility of rousing the sleeper, combined with the absence of any evidence of a local cerebral lesion or a toxic cause.

Other diagnostic symptoms are the pallor and vascular depression, the occurrence of convulsive phenomena of hysteroid type, and the history of other manifestations of hysteria. These symptoms sufficiently distinguish trance-sleep from apoplexy, for which, at the onset, it is sometimes mistaken. The distinction from catalepsy rests on the absence of the *flexibilitas cerea*, but catalepsy is merely a variety of trance. The peculiar tendency to brief sleep termed *narcolepsy* is distinguished from trance by the shortness of the periods of unconsciousness. Thus a man had from youth fallen asleep for a few minutes under various influences, and always did so when a probe was passed down a nasal fistula. It is to be remarked, however, that the term *narcolepsy* has been also applied in America to cases of true epilepsy, in which the attacks of *petit mal* are characterised by sudden somnolence.

In cases of 'death-trance,' in which no sign of vitality can be recognised, the presence of life may be ascertained (1) by the absence of any sign of decomposition; (2) by the normal appearance of the fundus oculi as seen with the ophthalmoscope; (3) by the persistence of the excitability of the muscles by electricity. This excitability disappears in three hours after actual death. In a case observed by Rosenthal, thirty hours after supposed death the muscles were still excitable, and in forty-four hours the patient awoke. *See* DEATH, Signs of.

Deepening sleepiness, not amounting, however, to coma, and scarcely to be called stupor, has attended some cases of subacute inflammation of the region of the oculo-motor nuclei described by Wernicke—a curious fact considering the manner in which relaxation of the levator is associated with ordinary sleep. Lastly, a benign form of 'summer somnolence' observed among the Swiss, has been termed 'Gerlier's disease.'

PROGNOSIS.—In cases of hysterical lethargy the prognosis is fairly good. The attack usually passes off. In very rare cases death has occurred. The slighter the degree of the trance, the shorter is likely to be its duration. The prognosis is grave only when lethargy has been preceded by a state of great physical depression, and is the most serious when the condition succeeds an acute disease.

TREATMENT.—The treatment has to be directed to two ends: the maintenance of life, and the arrest of the trance. Advantage must be taken of any intervals of semi-consciousness to give nourishment in a concentrated form. If swallowing is continuously impossible, food must be given by the nasal tube, or by enemata. Warmth should be applied to the extremities, and care taken to prevent bed-sores. In severe cases, every attempt at arrest is often fruitless. Errhines, as snuff, have usually no influence, and it is only in slight cases that this, or stimulation of the skin, as by sinapisms, is effective. The most powerful cutaneous excitant is strong faradisation. In a case under the writer's notice, which had lasted for thirty-six hours, strong faradisation to the arm quickly roused the patient. In another case, which lasted for several months, this treatment had, for a long time, no influence; afterwards the patient could be partially roused for a short time by faradisation, and by repeating the application at the same hour every day a tendency to periodical waking was established, the remissions became longer and more complete, and the attack was ultimately brought to an end. Nervine stimulants, such as ether and valerian, may be given by the bowel, or sulphuric ether may be injected subcutaneously. Alcohol must be given with caution and in small quantities; enemata of strong coffee are often more useful. A remedy which, from its effect on the vascular system, would certainly deserve trial in trance, is the inhalation of nitrite of amyl. Transfusion of blood has been proposed, and would be justified in cases following exhausting disease. The recurrence of attacks must be prevented by the improvement of health, physical and moral.

2. **African Lethargy.**—This form of trance is described separately. *See* NEGRO LETHARGY. W. R. GOWERS.

TRANSFUSION OF BLOOD.—

SYNON.: Fr. *Transfusion du Sang*; Ger. *Transfusion des Blutes.*

DEFINITION.—The injection of blood from the human subject, or from one of the lower animals, in a pure or defibrinated condition, into the veins of a patient.

DESCRIPTION.—This operation was invented in the middle of the 17th century, and is now fully established as a proceeding of great value; but authorities are still divided as to the best mode of performing it. Transfusion is most frequently undertaken as a means of saving life after a great loss of blood, and most commonly after *post-partum* hæmorrhage. It has also been employed in cases of profound anæmia from other causes, as in leucocythæmia, phthisis, and pernicious anæmia, and its use has been suggested in the so-called blood-diseases, as fevers or pyæmia. But the benefit derived from it in these cases is at most only temporary, and it is probable that the operation will ultimately be limited to cases of anæmia from hæmorrhage. Transfusion benefits the patient, first, by increasing the quantity of fluid entering the ventricles, and so encouraging their action; secondly, by increasing the number of blood-corpuscles which, as the carriers of oxygen, are essential to life; thirdly, by supplying albumin, and so giving nourishment at a time when it is probably impossible to do so by any other means. For none of these purposes is the fibrin of the blood essential, and consequently many operators prefer to defibrinate the blood, by which much trouble in the operation is saved. Experiments on the lower animals, and observations of operations performed on the human subject, seem at present to indicate that defibrinated blood is as efficient as pure blood. Yet when all the necessary appliances are at hand, pure blood is undoubtedly the most natural fluid to inject. When human blood has not been available, the blood of a calf, a sheep, or a lamb has been used instead, apparently with equally beneficial results. The difference between the size of the corpuscles in these animals and in man is of no consequence, as those of man are the larger. The corpuscles from these animals probably break up very soon, as hæmatin has been found in the urine the day after transfusion with lamb's blood; but they no doubt serve as carriers of oxygen for a short time, during which the patient may rally.

The dangers of transfusion are not very great; but as cases have occurred in which the donor of blood has died in consequence of the operation, it should not be undertaken without a clear prospect of benefiting the recipient. Care must be taken that air is not injected with the blood. The experiments of Oré (*Études historiques et physiologiques sur la Transfusion du Sang*, Paris, 1868) have, however, shown that this danger has been much exaggerated. A bubble of air does no harm; the quantity to cause death must be considerable. Too great care cannot, however, be taken to exclude air, as fatal cases have occurred from this cause. The injection of clots giving rise to embolism, and perhaps to pyæmia, is always considered one of the dangers of the operation; but evidence is wanting to show that it has been a frequent cause of death, or that in all the cases in which pyæmia or septicæmia followed the operation it was due to this cause. One case is recorded by Jürgensen (*Vier Fälle von Transfusion des Blutes*, Berlin, 1871) in which red maculæ formed on the skin after the operation, which subsequently suppurated. These were supposed to be due to minute fragments of fibrin injected with the defibrinated blood. Dr. Madge (*Brit. Med. Journ.* vol. ii. 1874; and *Obst. Journ. of Gt. Brit.* 1874) has shown, however, that with care no such fragments need be left after whipping and straining. The wounds left after transfusion present nothing special, and are to be treated as ordinary venesection wounds. The difficulties with which the operator has to contend are not great when defibrinated blood is used. When pure blood is used by any but the immediate method of transfusion from artery to artery, or vein to vein, there is some necessary hurry, as the operation must be finished before coagulation sets in. To avoid this, Dr. Braxton Hicks recommends the addition of a solution of phosphate of sodium (℥j to Oj), in the proportion of one of the solution to three of blood; and Sir B. W. Richardson a solution of liquor ammoniæ (♏xx and distilled water ℥j), to be added to a pint of blood. Both these solutions have the power of arresting coagulation. There is often some difficulty in finding the collapsed and empty vein of the patient. An ordinary venesection incision is useless; the vein must be cut down upon, picked up with forceps, and then opened.

Transfusion is either *mediate* or *immediate*. In the *mediate* operation the blood may be either defibrinated or pure. When pure blood is used, the vein of the patient must first be exposed and opened, and a silver cannula introduced. It is better to use an assistant's fingers (rather than a ligature) to retain the cannula in its place. It is well to allow a drop or two of the patient's blood to escape from the cannula, if possible, to make sure it contains no air; or it may be filled with warm water or a solution of phosphate of sodium. While this is being done, the donor is bled into a clean vessel. No precautions need be taken to keep the blood warm. Cold delays coagulation. As soon as sufficient blood has been obtained, it is transferred to a syringe which is provided with an india-rubber tube. Care being taken that the tube and syringe contain no air, they are now connected with the cannula, and the blood slowly injected. Innumerable instruments have been invented for this operation, with the objects of saving time and ensuring against the entrance of air. It is impossible to describe them here. The best known are Hewitt's (*Brit. Med. Journ.* 1863, vol. ii.), Hicks's (*Guy's Hosp. Reports*, 1869), Higginson's (*Liverpool Med.-Chir. Journ.* 1857), and Mathieu's (*Bull. Acad. de Med.* Paris, 1867). In this last the blood is received directly from the donor into a funnel at the top of the syringe, and great rapidity of operation is consequently attained. An ingenious instrument, which it is impossible to describe without a drawing, was introduced into London in 1877 by Dr. J. Roussel. When all its parts are in good order it doubtless works extremely well, but it is somewhat complicated and uncertain in its action (Dr. J. Roussel on *Transfusion of Human Blood*, with a preface by Sir James Paget; London, 1877). When defibrinated blood is used, complicated instruments are unnecessary. The blood must be received into a clean vessel, and whipped with a clean stick or a twisted glass rod, till fibrin ceases to separate. The whipping must be done gently, so as not to injure the blood-corpuscles, or to break off minute fragments of fibrin. After whipping, the blood must be carefully strained two or three times through some clean linen. It may then be injected as above described.

The operation of *immediate* transfusion was reintroduced by the late Dr. Aveling (*Obst. Journ. of Gt. Brit.* 1873). In this operation two cannulæ are required, one for the vein of the donor, and one for that of the patient. They are connected with each other by an indiarubber tube, with a small ball in the middle and a stopcock at each end. The cannulæ, having been inserted, are allowed to fill with blood so as to expel the air; or that in the patient's vein, if no blood will flow into it, is filled with warm water. The indiarubber tube having been previously filled with warm water, is now applied to the cannulæ, and the stopcocks turned on. The small ball is then squeezed, while the tube is pinched on the side of the donor by an assistant. This drives the fluid in the tube into the vein of the patient. The tube is next pinched on the side of the patient, and the ball allowed to expand and then emptied as before. Each squeeze of the ball drives in three drachms of blood.

Immediate transfusion *from artery to vein* has only been performed when an animal has been the donor. In this operation the carotid artery of a lamb or calf is connected directly with the vein of the patient by means of a simple indiarubber tube, with a cannula at each end. The force of the animal's circulation is quite sufficient to carry the blood into the patient's vein. As the result, however, of a series of experiments carried out at the request of the Obstetrical Society of London, Professor Schäfer has recommended immediate transfusion *from artery to artery* as the most efficacious method of performing the operation (*Trans. Obst. Soc. Lond.* 1879, vol. xxi.). The quantity injected in any of the foregoing methods of operating varies with the effect produced. Sometimes as much as a pint has been introduced. Half that quantity is usually sufficient to produce a marked effect. Marcus Beck.

TRANSFUSION OF MILK.—This operation, or, as it is more correctly termed, *Infusion or Intravenous Injection of Milk*, has been recommended in America by Thomas (*N. Y. Med. Journ.* May 1878), Howe (*N. Y. Med. Rec.* 1878, p. 443), and others, as a substitute for transfusion of blood. In this country it has been practised and recommended chiefly by Dr. Austin Meldon, of Dublin (*Med. Press and Circular*, Oct. 22, 1879; and *Lancet*, 1880, vol. i. p. 527). The subject has been experimentally studied in France by Béchamp and Baltus, Laborde, Culcer, and others, with the result of showing that a small amount of milk may be injected without any evil consequences; but if the quantity be too large and too rapidly injected, the animal dies asphyxiated after severe dyspnœa. The *post-mortem* examinations showed minute hæmorrhages and embolisms, caused by the milk-globules sticking in the capillaries of the lungs, kidneys, brain, and other viscera. The numerous cases in which the operation has been performed on the human subject show that it can be safely undertaken, provided that, in addition to the usual precautions observed in intravenous injections, the following points are attended to. The milk must be freshly drawn from a cow or a goat. A goat may be brought to the bedside of the patient. The milk must be alkaline; and this is best secured by the addition of a small quantity of carbonate of ammonium. It must be raised to a temperature somewhere near that of the body. Under no circumstances must more than 4½ ounces be injected (Meldon). If any dyspnœa is observed the operation must be at once arrested. The injection is usually followed by a considerable rise of temperature; and there may be some disturbance of respiration, which passes off in a short time.

The operation is reported to have been successfully performed in cases of cholera, pernicious anæmia, phthisis, and loss of blood; and it may perhaps be recommended as a last resource in some of these conditions if no blood can be obtained for transfusion. Injection of milk can only effect two of the purposes of transfusion. It can increase the amount of circulating fluid; and it can, in an imperfect way, supply food at a time when it could not otherwise be taken; but it can do nothing to increase the oxygen-carrying power of the blood. Its inferiority to immediate transfusion is self-evident; and it is more dangerous and less efficacious than the transfusion of freshly defibrinated blood, either of man or animals, or of saline solutions. Marcus Beck.

TRANSFUSION OF SALINE FLUIDS.—Great temporary benefit and the occasional saving of life have been secured by the intravenous injection of saline fluids.

Composition and Method.—The saline fluid recommended by Little for use in the treatment of cholera was composed of chloride of sodium, 50 grains; chloride of potassium, 3 grains; sulphate of sodium and carbonate of sodium, of each 2 grains; and water 1 pint. Two drachms of absolute alcohol may be added if it be thought desirable. More recently the so-called 'normal' saline solution, namely, 0·6 per cent. of chloride of sodium in distilled water, with or without the addition of alcohol, has been more commonly employed, and apparently with equally good results. The fluid should have a temperature of 98° to 100° F. A considerable quantity may be injected apparently with advantage: the amount employed has in some instances been as much as four pints. The simplest possible apparatus should be employed: a nozzle to fit into the opening in the vein, to which is attached, by means of a few feet of indiarubber tube, the glass part of an ordinary syringe. The fluid is poured into the syringe (or funnel), which is held a foot or two above the level of the patient's body; and should any obstruction occur to the flow, this may easily be overcome by the introduction of the piston.

Action and Uses.—The injection of saline fluid possesses only the first of the three functions detailed at the commencement of the article on Transfusion of Blood. It has, however, proved useful in cases of severe bleeding, such as *post-partum* hæmorrhage; and has recalled the patient to consciousness, at all events for a time, in cases of shock. It has also been employed in diabetic coma.

It is perhaps not out of place to add that it has been asserted that many of the benefits of intravenous injection of a saline fluid have been obtained by injection of a large quantity of a similar fluid into the rectum.

Rickman J. Godlee.

TRANSPOSITION OF VISCERA. *See* Organs, Displacement of.

TRANSVAAL, The. — *See* Africa, South.

TRAUMATIC (τραῦμα, a wound).—That which is associated or connected with a wound or injury, for example, *traumatic fever* and *traumatic aneurysm.*

TREATMENT. — *See* Disease, Treatment of; and Therapeutics.

TREMENS, DELIRIUM.—*See* Delirium Tremens; and Alcoholism.

TREMOR (Lat. trembling).—The most delicate form of clonic spasm, consisting of successive movements of very small amplitude. Tremors are seen principally in the hands, the head, the tongue, or the facial muscles, as a result of disease or of old age. They are commonly spoken of as 'coarse' or 'fine,' according to the amount of movement which they involve. For some account of the mode in which tremors are related to other disorders of movement, *see* Motility, Disorders of.

TRICHIASIS (θρίξ, the hair).—A morbid condition in which the eyelashes are inverted towards the eye. *See* Eye, and its Appendages, Diseases of.

TRICHINA (τρίχινος, made of hair).—*See* Entozoa.

TRICHINOSIS or TRICHINIASIS.—*See* Entozoa.

TRICHOCEPHALUS (θρίξ, a hair; and κεφαλή, a head).—*See* Entozoa.

TRICHOMONAS VAGINALIS (θρίξ, a hair; μονάς, a monad; and *vaginalis*, connected with the vagina).—A ciliated infusorial animalcule, discovered by Donné in the vaginal mucus, and somewhat resembling a spermatozoon. *See* Rape.

TRICHOPHYTON (θρίξ, a hair; and φυτόν, a plant).—A species of parasitic fungus, which attacks man and some animals. *See* Tinea Trichophytina.

TRICUSPID VALVES and ORIFICE, Diseases of.—*See* Heart, Valves and Orifices of, Diseases of.

TRIFACIAL NERVE, Diseases of. *See* Fifth Nerve, Diseases of.

TRISMUS (τρίζω, I gnash).—Lockjaw, or tetanic closure of the jaws; a prominent symptom in tetanus. *See* Tetanus.

TRISMUS NASCENTIUM or NEONATORUM (Lat.). — A form of tetanus occurring in newly born children. *See* Tetanus.

TROPHIC LESIONS.—Description. This name is given to various departures from healthy nutrition, which are caused (*a*) by the cutting off, from certain tissues or parts, of some customary nervous influence, as in the production of 'secondary degenerations' in the nervous system (*see* Spinal Cord, Diseases of, § 6), or in the production of rapid muscular atrophy, consequent upon the severance of or severe damage to motor nerves or their related ganglion-cells in the anterior cornua of the cord; and also to lesions or morbid changes which are caused (*b*) by some irritative or perverted influences passing *outwards* along sensory nerves to certain tissues, so as to weaken or otherwise disturb their nutrition. In this latter way, the nutrition of the skin and its appendages may be variously affected, leading to eruptions of different kinds, to atrophy, to ulceration, or undue proneness to inflammation, as well as to altered pigmentation of the skin or blanching of the hair. Or the nutrition of the joints may be affected, as in some forms of hemiplegia, and of locomotor ataxy more especially. In these various cases there may be disease, secondary or primary, of the grey matter of the spinal cord, or some irritative lesions of the sensory nerve roots or trunks.

Pathology. — Much dispute has taken place during recent years as to the modes in which such nutritive changes are brought about. Some have endeavoured to establish the existence of special 'trophic nerves,' and have taught that the various trophic lesions referred to above are to be explained by a cutting off or a perversion of the influences usually operating upon the tissues through such nerves. Others believe that these nutritive changes can be accounted for by altered states of excitation of the vaso-motor nerves, leading to spasm or dilatation of the vessels supplying the parts affected, and, as consequences, to the nutritive changes themselves (*see* SYMPATHETIC SYSTEM, Disorders of). Much evidence, however, could be cited against both these modes of explanation; and it seems, on the whole, more probable that trophic lesions are due either (*a*) to the cutting off of certain accustomed influences (*viâ* motor channels), or (*b*) to the action upon the tissues of perverted or unnatural influences (travelling in a peripheral direction *viâ* sensory channels).

On the subject of these trophic lesions *see* also SPINAL CORD, Diseases of, § 7; GLOSSY SKIN; and UNILATERAL FACIAL ATROPHY.

H. CHARLTON BASTIAN.

TROPICAL DISEASES. — Diseases incident to hot climates. *See* CLIMATE; DISEASE, Causes of; and the special diseases, such as CHOLERA, ASIATIC; CHYLURIA; DYSENTERY; FUNGUS-DISEASE OF INDIA; INTERMITTENT FEVER; LIVER, Diseases of; NEGRO LETHARGY; REMITTENT FEVER; and SUNSTROKE.

TUBERCLE (*tuberculum*, a little swelling).— SYNON.: Fr. *Tubercule*; Ger. *Tuberkel.*

There have been four stages in the history of tubercle, namely, the first, or etymological stage; the second, or stage of morbid anatomy studied by the naked eye; the third, or stage of morbid anatomy studied by the help of the microscope; and the fourth, or stage of experimental pathology.

Stage I.—This stage begins with the earliest writings on medicine. The word 'tubercle' has not yet been wrested from its original meaning—*tuberculum*, a little lump of any kind. And this primitive etymological meaning survives even in the present day. We still speak of 'tubercles' of the ribs and other bones; acne is a 'tubercular' disease of the skin, and so on. But down to the beginning of the nineteenth century, tubercle meant a little lump and nothing else.

Stage II.—At the beginning of the present century tubercle lost its simple etymological meaning, and acquired a pathological meaning. Tubercle is no longer a matter of special shape, for now it signifies a special structure. This great change concurred with the rise of morbid anatomy. And thus it came to pass. Many of the dead bodies examined were necessarily cases of pulmonary consumption, and in this form of disease it was that little morbid lumps or tubercles were discovered with especial frequency. Hence the tubercles found in phthisical lungs early showed a strong tendency to become emphatically the tubercles of pathology. We may remark this tendency in Morton (A.D. 1689), and in Baillie (1795). But it was Bayle (1803) who first broke with the ancient meaning altogether, and introduced the second stage of opinion. Debates concerning tubercles are henceforth debates concerning morbid structures.

Bayle thus defines tubercle: A homogeneous substance; always opaque; in colour, white or dirty white, sometimes yellowish, sometimes greyish; in size, from a milletseed to a chestnut. He makes the criterion of tubercle to consist in its opacity. Now this opacity is most marked in the cheesy products of degeneration. Therefore, in other words, the criterion of tubercle consists in the cheesy state. Cheesy matter, wherever found, in the shape of a little lump or not, is the tubercle of Bayle. He called that tubercle which Baillie had called scrofulous matter.

Bayle did not, and could not, overlook the fact that the lungs sometimes contain little nodules which are translucent. He would not call them tubercles because they lacked his note of tubercle, opacity; he called them granulations. Granulations are never opaque. And so, between tubercles and granulations he drew an excessively strong distinction.

It was not long before Laennec (1819) reunited what Bayle had put asunder, by showing that granulations at length became opaque. And, therefore, he enlarged the definition of tubercle, so as to make it include, not only actual, but also potential cheesy matter. Thus Laennec's tubercle acquired a most inclusive pathological meaning. Moreover, he remarked that tubercle sometimes involves large, irregular tracts of tissue, a condition which he distinguished by the name of tuberculous infiltration. Each of these forms, the nodular and the infiltrated, he subdivided into three—the transparent, the semi-transparent, and the opaque or cheesy. Hence six forms of tubercle in all—three nodular, namely, the transparent or Bayle's granulations, the semi-transparent or miliary, and the opaque or crude yellow tubercle; three diffused, namely, the transparent or gelatiniform infiltration, the grey or semi-transparent infiltration, and the yellow or opaque. Laennec's descriptions relate especially to the lungs of adults. But the structure of the lungs makes the study of tubercle singularly difficult in them, and it is easy to note that our debates concerning tubercle in general show an unconscious leaning towards pulmonary tubercle in particular. The writers do not say that this is wrong; one feels that if one could master tubercle in the lungs the rest would soon follow.

Laennec's unit began to be broken up when men set themselves to discover the seat of tubercle. Carswell (1838) proved, what Broussais had guessed, that crude tubercle was often formed within the cavity of the pulmonary air-sacs. Thomas Addison (1845) went much farther. He began by examining genuine pneumonia, which he found to have its original and essential seat in the air-cells of the lungs, and the ordinary pneumonic deposits are poured into these cells. And when he, like Carswell, found this to be the chief seat of Laennec's crude yellow tubercle and grey and yellow tubercular infiltrations, he declared that, if called upon to give an expressive name to these lesions, he would venture to designate them scrofulous pneumonia. The case was altered with respect to the granulations; these he found to be seated in the delicate filamentous tissue which forms the slight filmy parietes of the air-cells. Let it be understood that Addison's criterion of tubercle lay in its formation in the septa of the air-sacs; he denied the criterion to be cheesiness, and thus, in matter of fact, his use of the word 'tubercle' was almost the exact contradictory of Bayle's. Addison revived in some degree Baillie's scrofula. The other forms of Laennec's tubercle, Addison conceived to be inflammatory exudation, mingled or not with his own true tubercle. It seems as if the naked eye could not carry us much farther.

Stage III.—About this time the microscope began to be used for examining healthy and diseased tissues. Cheesy matter being commonly deemed the most characteristic form of tubercle, men naturally supposed that the microscopical characters of tubercle would be found in cheesy matter. Tubercle being thought, moreover, to possess perfectly distinct naked-eye characters, it was expected that its minute structure must likewise be peculiar and distinct. And thus it came to pass that Lebert (1844) found certain bodies in cheesy matter which he believed to be characteristic of tubercle, and which he called tubercle-corpuscles. These corpuscles not being found in the transparent granulation, some persons went so far as to deny its tubercular nature, and so revived Bayle's doctrine, in all its severity, upon a microscopical platform. But William Addison (1849) came to a very different conclusion respecting the characters of pulmonary tubercle. He repeatedly examined with the microscope the material deposited in the air-cells of the lungs in pneumonia, and compared its characters and appearance with that forming a tubercle, without being able to detect any more essential or specific difference between them than exists between purulent matter recently excreted and that of an old chronic abscess. This was a microscopical confirmation of Thomas Addison's doctrines. Virchow (1850) arrived at the same opinion, namely, that there was nothing characteristic of tubercle in cheesy degeneration. For instance, nowhere is the cheesy degeneration better seen than in the enlarged glands of scrofula; yet, examine these glands before they become cheesy, and nothing more (so Virchow said) than a simple hyperplasia will be found, and no new-formation. On the other hand, examine tubercle before it becomes cheesy, examine the transparent granulations, and it will be found to possess a distinct lymphatic character. But granulations are formed in the connective tissue; hence they are heteroplastic. So that Virchow's tubercle signifies a heteroplastic lymphoma. The characteristic tubercle is not opaque, but transparent; in this respect Virchow's doctrine was the exact opposite of that taught by the French school. The criterion of tubercle with him is not cheesiness, but heteroplasia. Of late years both parts of Virchow's definition have been assailed: first, the connective tissues which are infested by tubercle have been shown to possess in many places a true lymphatic character, so that tubercle, if a lymphatic growth, may be simply hyperplastic as well as heteroplastic; next, the lymphatic character of tubercle has been put in question by the investigations of Langhans and others. Thus Virchow's distinction between tubercle and scrofula becomes untenable; but we will postpone further discussion of these matters for the present.

Stage IV.—The results of experiment upon living animals, or what is commonly called the inoculation of tubercle, will be narrated at the end of this article. Enough to say in this place that most important changes in the doctrines of both tubercle and scrofula have been almost entirely due to the experimental pathology of recent years.

Here ends the preliminary historical sketch. Now we will inquire into the present state of opinion concerning the characters of tubercle.

I. Concerning the structure of single tubercles.—The formation of tubercle begins at distinct foci. The primitive tubercle is a microscopic body. W. Addison (1849) taught that it consists, in greater part, of corpuscles, like blood-leucocytes, or like the corpuscles of lymph and of pus. Rokitansky (1855) showed that giant or myeloid cells are sometimes found in tubercle. Virchow (1863) taught that tubercle has a more histioid or tissue-like structure, which, on the whole, resembles most the tissue of a lymphatic follicle; so that, in the case of the spleen, tubercle is not always easily distinguished from a Malpighian body. In a tubercle there are corpuscles embedded in a reticulum. The corpuscles are round; and most of them are like lymphatic corpuscles, smaller than blood-leucocytes; some, however, are larger, it may be twice or thrice. The corpuscle is colourless, translucent, slightly granular, and easily broken up. In the fully developed cell there is a single nucleus, small, tolerably homogeneous, often shining. The larger cells contain two, three, or even as many as twelve nuclei. The reticulum consists of a fine network of connective-tissue fibres. When vessels are present in the tubercle, they are not new-formations, but only remnants of the tissue in which the tubercle has been formed. According as the cellular or the fibrous element of the tubercle predominates, it may be called cellular or fibrous tubercle, the former being more common. The fibrous element sometimes predominates so much that the tubercle can be distinguished from a small fibroma only by a concurrence of the more common cellular form, or by a tendency to undergo the further changes of tubercle, especially the cheesy change. In the fibrous tubercle there are often found large, roundish, epithelioid cells, with large oval or round, sharply defined nuclei. From this description it will be seen that Virchow recognised lymphoid, epithelioid, and myeloid or giant-cells, among the elements of tubercle. Langhans (1868) was the first to lay much greater stress upon the giant-cells; he found them to be an almost constant element of tubercle in any part. He believed that the tubercular giant-cell had characters proper to itself, namely, a finely granular protoplasma, and nuclei of equal size, peripheral, and arranged in radiate fashion. In cellular tubercle, the epithelioid cells are arranged around the giant-cell. In fibrous tubercle a giant-cell is always present at the very centre. Wagner (1871) described tubercle under the name of tubercular (*tuberkelähnlich*) lymphadenoma, the structure being the same as that of a lymphatic follicle (namely, lymphoid corpuscles, and many nuclei almost destitute of surrounding protoplasma, embedded in a fibrous reticulum), and in the middle of each tubercle a giant-cell. Schüppel (1871), who devoted himself chiefly to tubercle of the lymphatic glands, considered the gigantic cell to be an essential (though not peculiar) element of tubercle. A primitive tubercle consists of a central giant-corpuscle, that is to say, a mass of protoplasma of very varied form, spherical, flat, or elongated; the edges even, or provided with more or fewer processes; more or less granular; and containing a large number of nuclei, to be reckoned by the score, even as many as two or three hundred. Around this giant-cell lies a zone of epithelioid cells, which make up the greater part of the tubercle. They are very delicate, easily broken down, and the fact that tubercle has been supposed to consist chiefly of lymphoid corpuscles is due to the setting free of the epithelioid nuclei, which have been mistaken for leucocytes. Lastly, true lymphoid corpuscles are scattered through the tubercle, filling up the interstices between the other cells as it were. In fibrous tubercle there are no epithelioid cells, a fact which Schüppel believes to indicate an arrest in the growth of the tubercle at an early stage. Supporting all these cells, there is a reticulum like that of lymphadenoid tissue. These primitive tubercles contain neither blood-vessels nor lymphatics. Friedländer (1874), with especial reference to these giant-cells, very truly insists that they are by no means peculiar to tubercle; on the contrary, they are found in a number of other structures, both healthy and morbid. Moreover, he maintains that there are no distinguishing characters in the giant-cells of tubercle. What has been considered the reticulum of a tubercle, Friedländer asserts to be the result of the hardening processes employed in the preparation of the microscopical specimen; in the fresh state there is nothing but a small quantity of amorphous intercellular matter. Rindfleisch came to the conclusion that large epithelioid cells are the most characteristic elements of tubercular and scrofulous formations.

This conflict of opinion continued until Koch's experimental researches revealed a decisive test of what is tubercle.

II. Concerning the origin of tubercle.—William Addison believed that the lymphoid corpuscles of tubercle were the result of exudation from the blood, through the walls of the vessels. Virchow taught that tubercle proceeds from a proliferation of the fixed corpuscles of sundry tissues, especially the connective tissue and its allies, namely, marrow, fat, and bone. Hence tubercle is essentially heteroplastic, that is to say, lymphatic tissue is formed in parts where it does not naturally exist. But is there, then, no such thing as tubercle of the lymphatic structures? This is a troublesome question for Virchow. However, he does not deny that tubercle may be found in lymphatic glands; he supposes that it is formed, not in the follicles themselves, but in the connective-tissue trabeculæ which support them; also, that sometimes an adventitious connective tissue springs up in the gland in consequence of chronic inflammation, and that the tubercle grows in this new tissue. Yet Virchow was not without misgivings respecting his doctrine of the heterology of tubercle, because he saw the close relationship which exists between connective and lymphatic tissues. He pointed out (1856) the frequency with which tubercle is seated in the outer coat of the small blood-vessels, and especially those of the cerebral meninges. Now Robin (1855) and His (1865) showed that this outer coat, or adventitia, is a lymphatic tissue. Neumann (1868) showed that marrow is a lymphatic tissue. In this way, fresh difficulties arose with Virchow's heteroplastic doctrine. In fact, the opposite opinion gained ground, that tubercle is commonly hyper- or homœoplastic. Wilson Fox (1868) and Burdon Sanderson (1868) held that it is very often nothing but a hyperplasia or overgrowth of pre-existing lymphadenoid tissue. Lymphadenoid tissue has been found to be much more extensively present in the healthy body than Virchow thought; for instance, in the submucous tissue of the whole alimentary canal; in the conjunctiva; around the smaller bronchia; around capillary tufts beneath the epithelium of the pleura and peritoneum; around the smaller arteries in many parts, such as the pia mater, liver, spleen (constituting the Malpighian bodies), and choroid; besides the marrow, spoken of before. And all these are favourite seats of tubercle. So much for the lymphadenoid tissue as a seat of tubercle. Klebs (1868) maintained that tubercle of the serous membranes arises within the lymphatic vessels, by a multiplication of their epithelium. And Rindfleisch (1871) describes, under the name of lymphangitis tuberculosa, a kind of fibrous tubercle often present around phthisical cavities. Each tubercle consists of a dense fibrous capsule, within which lie concentric layers of spindle-shaped, anastomosing cells. The tubercles are, in fact, developed from lymphatic vessels, by a metamorphosis of the endothelium and outer tunic; the remnant of the lumen of the vessel may often be found in the middle of the tubercle. Last of all, a fibrous sclerosis of the whole takes place. Aufrecht (1869) supposed that tubercle was formed around the lymphatics, and was therefore a perilymphangitis. But Sanderson declares that Klebs and Aufrecht mistook veins for lymphatics, and that the perilymphangitis of the latter is a hyperplasia of the lymphatic sheath of blood-vessels. Wagner (1871) leaned to the belief that tubercle (his lymphadenoma) is always heteroplastic, even when it occurs in parts which naturally possess a certain quantity of lymphadenoid tissue. And Rindfleisch (1871) teaches that the lymphoid cells of tubercle do not come directly from the blood, but from proliferation of the fixed cells of connective tissue; the endothelium of blood and lymphatic vessels, the epithelium of serous membranes, lungs and kidneys, and even the muscle-cells of the smaller bronchia and vessels, undergoing a tubercular metamorphosis. Schüppel (1872) reduces the question to the origin of what he deemed to be the most important part of tubercle, namely, the giant-cell. It arises, he thinks, within a blood-vessel. Masses of molecular matter, very tenacious and adherent, grow up in small blood-vessels (capillaries or small veins), and become bigger and bigger, until the vessel is quite choked, or even distended at the spot. At first there are no nuclei in the protoplastic mass, but afterwards they begin to appear; and their number is proportionate to the age of the corpuscle. Where the nuclei come from is uncertain. The epithelioid cells next appear around the giant-cell, and are most likely derived from processes of the giant-cell. The lymphoid cells come from the cells of the tissue in which the tubercle is formed. The reticulum, in chief part, is a neoplasm; it grows with the multiplication of the cells, and is always connected with the gigantic corpuscle. So soon as the giant-cell becomes surrounded by other cells, the wall of the blood-vessel disappears. Other authorities differ from Schüppel with regard to the origin of the giant-cell: some supposing it to be formed from the endothelium, some from blood-leucocytes, and some from free protoplasm. Others considered that it resulted from fusion of several cells. And here the question rested until new light was shed upon it by experimental pathology.

III. **Concerning the growth of tubercles.**—The primitive tubercle increases in size until it becomes visible to the naked eye. The enlargement is brought about by the formation of fresh tubercular foci around the original focus; so that when six or more of the primitive tubercles become agglomerated into one body, it becomes visible as a small nodule (tuberculum). Sometimes the agglomeration does not assume the nodular form, but is diffused and of irregular shape; this is called an infiltration. The difference between nodular and infiltrated tubercle is merely a naked-eye difference; whether the confluent tubercles retain the nodular shape or not, the primitive tubercle is always a tuberculum. 1. *Nodular tubercle* corresponds to most of Bayle's granulations, and Laennec's miliary tubercles, which were spoken of before. The epithet 'miliary' is much older than Laennec, and has lost its original etymological meaning. Miliary tubercle may or may not be of the size of a millet-seed. Tubercle the size of millet-seed may or may not be miliary. All that is now meant by miliary tubercle is a small nodule, roundish, seldom larger than a hemp-seed, almost colourless or greyish, consistence almost equal to that of cartilage, and either quite transparent or opalescent. Lastly, miliary nodules may or may not be tubercular. Miliary tubercle must be distinguished from other small nodular neoplasms: minute disseminated carcinoma and sarcoma, lymphosarcoma, leukæmic nodules, small fibromata. The diagnosis depends upon the discovery of more definite lesions in the same body, and upon the microscopical structure. In the lungs, miliary semi-transparent nodules are sometimes wholly pneumonic in character. The peribronchitis of Virchow possesses, according to Wagner, a lymphadenoid structure, and may therefore be considered a tubercular lesion. 2. *Infiltrated tubercle*, when present in the lungs, corresponds with much of Laennec's gelatiniform and grey infiltration. The gelatiniform infiltration may often be seen surrounding nodular tubercles, in cases of acute pulmonary tuberculosis. In the liver, tubercular infiltration runs along the capsule of Glisson between the lobuli. In the cortex of the kidney, it appears as streaks between the bundles of tubuli, or as ill-defined roundish patches. Tubercle, not nodular, often may be seen alongside the small arteries in the cerebral meninges. Wagner describes a diffuse lymphadenoma (tubercle) of the pleura, which is indistinguishable by the naked eye from chronic pleurisy; and even the microscope shows all stages of transition between lymphadenoid and granulation tissue, in these cases. A similar diffuse lesion occurs in the mucous membranes.

IV. Concerning the lesions which surround tubercle.—Tubercle is commonly associated with surrounding hyperæmia, and with inflammatory exudations in the neighbourhood. These secondary lesions are well seen in the serous and mucous membranes. Pleurisy, peritonitis, pericarditis, local or general, are sure to follow upon tuberculosis of the respective membranes. In the mucous membranes, hyperæmia and catarrh are the necessary results. But in the tissues which are themselves undergoing transformation into tubercle an obliteration of the blood-vessels proceeds very quickly. Tubercle, wherever formed, is non-vascular; the only approach to vascularity is when tubercle surrounds arteries or veins without closing them.

V. Concerning the metamorphosis of tubercle.—Sooner or later, the tubercles, which have now been described, undergo sundry changes. These changes sometimes take place very quickly, certainly within two or three weeks from the formation of the tubercle. On the other hand, tubercle may remain unchanged for a long time, even for two or three years, as Schüppel's observations upon one case seem to prove. There are two kinds of metamorphosis—the fibrous and the caseous, and they correspond to the two kinds of tubercle which Virchow describes, the fibrous and the cellular. 1st. *The fibrous metamorphosis* is by far the less common. The reticulum of the tubercle becomes greatly hypertrophied, so as to constitute a dense intercellular substance, interspersed with a few small spindle-shaped nuclei. The cells of the tubercle undergo the caseous change. The result is either a small fibroma with a cheesy centre (which may afterwards calcify), or a simple fibroma, the cheesy matter being wholly absorbed. In the writers' opinion, there is reason to believe that much larger tracts of tubercular infiltration may undergo the fibrous metamorphosis—may cicatrise, in fact. Friedländer (1873) denied the fibrous metamorphosis altogether, and declared that it proceeds from the tissue around the tubercle, and not from the tubercle itself, which must caseate. Whether it be a direct or indirect result, the fibrous condition, when once attained, is permanent and final. This process represents the natural healing of tubercle. 2nd. *The caseous metamorphosis* is very much more common. To the naked eye minute white specks appear towards the centre of the tubercle; they become larger and more numerous, and at last coalesce. The caseous mass, at first firm and white, subsequently acquires a more yellowish colour, and may undergo softening and liquefaction. The microscope shows that the process is essentially a form of necrosis, or death of the affected tissues, 'necrobiosis' (Virchow). The cells shrivel, become indistinct, and often contain granulo-fatty particles. In this state they constitute the tubercle-corpuscles of Lebert. Similar changes take place in the reticulum, and ultimately all traces of the tissue-elements are lost, the result being a finely granular amorphous mass. This metamorphosis is regarded by Weigert and others as an instance of coagulative necrosis. But why tubercle should take on the cheesy metamorphosis could not be explained: the deficient supply of nutritious juices will not alone meet the case. The cheesy change usually begins before the tubercle has reached the size of a millet-seed. But sometimes much more minute granulations degenerate, and to this, the very smallest cheesy tubercle, Rilliet and Barthez have given the name of tubercular dust. The change begins much more quickly in generalised than in local tubercle. Large nodules, formed by the aggregation of smaller cheesy nodules, may reach the size of a peeled horse-chestnut. This caseous tubercle is the crude yellow tubercle of Laennec, and *the* tubercle of Bayle. Before Bayle it was called scrofulous matter, and looked upon as wholly a deposition from the blood. Unlike the fibrous metamorphosis, the cheesy change is not permanent: five further changes may occur: 1. Softening: the whole caseous mass breaks down into a molecular detritus of oily and albuminous particles. When the supply of blood allows of it, these molecules float in a serous fluid, which to the naked eye looks purulent: curdy pus, or a tubercular abscess. The abscess, when superficial, bursts, and leaves a tubercular ulcer. When all the caseous matter has been cast off, the ulcer may heal, and so the local disease come to an end. But usually the ulcer steadily enlarges, by the perpetual production and destruction of tubercles around it: this is phthisis, in the anatomical sense of the word. The cicatrix-tissue of tubercle has a tendency to contract strongly. 2. Capsulation: sometimes a capsule of dense fibrous tissue will form around the cheesy matter, whether softened or not. This is the encysted tubercle of Bayle. 3. Calcification: the oily particles become gradually replaced by carbonate and phosphate of calcium. The different degrees of calcification are denoted by such words as mortary, chalky, stony. In itself, it is a permanent change; but ulceration may occur around, and thus the petrified tubercle be discharged. 4. Absorption no doubt occurs to some degree. Virchow believes that cheesy glands may wholly disappear in this way. 5. Sloughing in mass may occur. The cheesy nodule becomes a sequestrum, which is gradually loosened by surrounding suppuration, until it separates, and lies loose in a cavity. The cheesy metamorphosis cannot be by any means looked upon as being peculiar to tubercle, although no doubt most common in tubercle. Simple inflammatory exudations, cancer, syphilitic gummata, lymphosarcoma, all sometimes undergo the same change.

VI. **Concerning the tubercular diathesis and dyscrasia.**—It was not possible that careful examinations of dead bodies should be made without two prominent characters of tubercle being noted, namely, the fact that certain tissues, organs, or persons are liable to tubercle, and certain others not so; also the frequency with which tubercles are disseminated over a number of organs in the same subject. Hence arose the doctrine of tubercular diathesis and dyscrasia.

1. *Tubercular diathesis* is a phrase first used by Bayle (1803), and means a particular disposition to the generation of tubercles. The contradictory word to diathesis is immunity, or privation of diathesis. The tubercular diathesis relates to tissues, organs, or persons. (*a*) Tissues: it has been already shown that the connective tissues (and especially the variety lymphadenoid tissue) are particularly predisposed to tubercle. The other tissues—namely, the epithelial, and the higher, muscular and nervous tissues, have been said to possess complete immunity. Some would deny this last assertion, but their opinions have been narrated before, and need not be repeated here. Of late years tubercles have been found in sundry morbid tissues. Köster (1869), in cases of scrofulous disease of joints, found innumerable tubercles embedded in the granulations; not only in those which spring from the synovial membrane and bone, but also in those which line abscesses or sinuses. Friedländer (1873) declares that, under these conditions, tubercles are never absent. They are visible, even to the naked eye, as whitish or greyish specks, surrounded by a ring of enlarged capillaries. He finds tubercles in scrofulous ulcers of the skin, and in the walls of scrofulous abscesses, cutaneous or connected with caries of bone. The microscopical structure of these tubercles is identical with that which Schüppel has assigned to tubercle of the lymphatic glands, and which has been already described. (*b*) Organs: the serous membranes (pleura, peritoneum, pericardium) are a very frequent seat of tubercle. Endocardium, very uncommon. Dura mater, not very common. Pia mater, very common. Ependyma, uncommon. The mucous membranes (alimentary, respiratory, genito-urinary), very common. Lymphatic glands and lungs, most common. Liver, spleen, kidneys, common. Suprarenals, not very common. Testes, not uncommon. Prostate, not common. Heart, not very common. Brain and spinal cord, tolerably common. Salivary glands and pancreas, uncommon. Ovaries, voluntary muscle, and thyroid, very uncommon. With regard to the skin, tubercles have been found around scrofulous ulcers; and Friedländer (1872–4) has assigned to lupus a microscopical character identical with that of tubercle. The diathesis of organs seemed to be partly explained by the diathesis of tissues. Lymphatic organs are predisposed; and hence the spleen is prone to tubercle whilst the thyroid is not; also the intestines are more liable than the stomach, because they are much richer in lymphatic structures. But since tuberculosis has been proved to be an infective disease depending on the presence of a specific microbe, a modification of these views has become necessary, as will be seen in the section on Experimental Pathology. (*c*) Persons: the tubercular diathesis, with respect to persons, will be discussed under the head of Ætiology.

2. *Tubercular dyscrasia.*—The word 'dyscrasia' signifies a mis-composition, or a qualitative lesion. Strictly speaking, there may be a dyscrasia of any tissue, but the word has come to be applied to qualitative lesions of the blood only. The dyscrasia which is believed to exist in tuberculosis, and to be peculiar to it, is called tubercular. Bayle was the first to note the frequency with which tubercle implicates a number of organs in the same subject and at the same time. Laennec remarked that the tubercles often seem to have been developed in distinct crops: the age of the tubercles being judged of by the degree of their degeneration. So that he came to speak of primary and secondary eruptions of tubercle. He noted that a secondary eruption often seemed to follow the softening of the primary tubercle. And this he deemed to indicate an actual and peculiar change in the juices of the part—a local dyscrasia: as if the primary tubercle were the source of an infection. It is then the multiple eruption of tubercle which suggests the notion of a dyscrasia. For the matter stands thus. The multiple eruption is either protopathic or deuteropathic. Either many organs simultaneously and spontaneously generate tubercle, or they are simultaneously subjected to a common tuberculising influence. Of the two hypotheses, the latter is certainly the more probable. And if so, it is not asking much to suppose that the common cause exists in the common bond of all organs and tissues—that is to say, the blood. And granting this, the further question arises: How does the blood acquire this tuberculising property? Is it protopathic or deuteropathic? Is it a spontaneous generation of the blood, or is it derived from some other source? Now, the prevailing theory of dyscrasiæ asserts

that every dyscrasia is due to the constant afflux of morbid material derived from foci external to the circulating blood itself: in other words, dyscrasiæ are always secondary to a local lesion. The justification of this doctrine is believed to be found in certain dyscrasiæ which seem to be less obscure than the tubercular; for instance, pyæmia and melanæmia. Admitting that, in the case of the tubercular dyscrasia also, there is a necessary local antecedent lesion, we have next to inquire what this lesion is, both in itself and in its relation to the blood.

First, concerning the *nature of the lesion* which infects the blood. Dittrich (1853) taught that detritus, derived from the breaking up of tissues of any kind, and entering the blood, would produce the tubercular dyscrasia. But to this doctrine it is justly objected that detritus, the result of degenerations, is often absorbed and is not followed by tubercle. There must be something peculiar to the detritus which sets up tubercle; what we may call a tubercular virus. Buhl (1857) held that this virus proceeded from the sundry forms of Laennec's tubercle alone: that is to say, from undegenerated tubercle, and from any kind of cheesy matter. He remarked, what is very true, that it is exceedingly uncommon to find disseminated miliary tubercle, without also finding cheesy matter somewhere, especially in the bronchial and mesenteric glands, and in the lungs. And no one would deny that the formation of the cheesy matter must have preceded, in point of time, the formation of the miliary tubercle. Against Buhl's theory there lie three objections, but they cannot be said to overthrow the theory by any means. Cheesy matter often occurs without the tubercular dyscrasia; but this proves nothing more than that cheesy matter sets up the dyscrasia under certain conditions only, or that all cheesy matter will not set up the dyscrasia. In very rare cases of general tubercle no cheesy matter has been found; but it is not denied that recent undegenerated tubercle may infect. The last objection is this: the tubercular dyscrasia implies the tubercular diathesis; and it is not surprising that the signs of former tubercular disease, in the form of cheesy matter, should be found in persons who have died from a more general tuberculosis; but this objection will lose much of its force when we have discussed our second topic, which we will now proceed to do.

The *relation between the local lesion and the blood*, or the mode in which the tubercular dyscrasia is developed. There are two ways by which the blood is known to become contaminated. First, by a lesion of some part of the sanguiferous system. In several cases Weigert has found a tubercular growth involving the walls of the pulmonary veins. Koch and others have met with a similar lesion of the small arteries in different organs. The entrance of the virus into the circulating blood sets up a general tuberculosis, depending on the impaction of the specific microbes in the capillaries of various parts; in other words, an infective embolism. Secondly, by means of the lymphatic system: a source of infection which is extremely common. The local tuberculising lesion first of all infects its immediate neighbourhood, through the juice canals. In serous membranes, mucous membranes, the lungs, and the brain, it is very common to see what may be called the mother tubercle surrounded by a number of daughter tubercles. The lymphatic glands are next infected; and when they have become tubercular, they pour tubercular virus into the blood, and thus the disease is spread. In exceptional instances the thoracic duct itself may become invaded by tubercular infiltration, as shown by Ponfick.

VII. Concerning the experimental pathology of tubercle.—Passing over the earlier experiments of Cruveilhier, Lombard, Erdt, and others, we will come at once to Villemin (1865), who was the first to draw general attention to the present topic. He inoculated rabbits with fresh tubercle, both transparent and opaque; that is to say, he inserted small pieces of tubercle into an incision made through the skin of the animals. When the rabbits were killed, about a month afterwards, an abundant crop of tubercles was found in many of the viscera. On the other hand, Villemin proved that rabbits are not subject to spontaneous formation of tubercle. He concluded that tubercle contains a peculiar virus, which can be reproduced in the body. Since Villemin's time many pathologists have worked at the artificial production of tubercle. The results of their work may be conveniently arranged under six heads.

1. *Animals used in the experiments.*—In rabbits, guinea-pigs, oxen, sheep, goats, and monkeys, artificial tubercle is easily generated; in cats and dogs, not easily. Villemin failed in his attempts to inoculate a cock and a dove.

2. *Material inoculated.*—Villemin used fresh tubercle. But soon afterwards (1867) Andrew Clark and Waldenburg succeeded in rendering rabbits tubercular, by inoculating them with materials other than tubercle. It was next found that not only animal tissues, but even the vegetable, such as a cotton seton or a piece of cork, could set up tuberculosis. And, lastly, the fact was discovered that a simple wound, into which nothing was inserted, would suffice to generate tubercle in rabbits, guinea-pigs, and certain other animals. However, Sanderson (1868) showed that, of all the means for producing artificial tubercle by inoculation, none is more certain or more active than the material taken hot from the

diseased glands of a living animal already infected. The dose required is almost infinitesimal. If a diseased gland is squeezed into a little distilled water in a capsule, and the slightly turbid liquid injected, results are certain. Both Sanderson and Wilson Fox (1868) discovered that when non-tubercular matters are inoculated, they become encapsuled by cheesy matter formed beneath the skin; so that the tubercles appeared to follow, not the material inoculated, but the inflammatory products which surround it. Wherefore it was thought that the infectious virus, which excites the general tuberculosis, is not introduced from without, but is generated by the animal itself; that the animal must possess a tubercular diathesis; and that, given the diathesis, any kind of inflammation, set up in any way, may call forth tuberculosis. Cohnheim and Fränkel at first obtained results similar to those of Clark and Waldenburg. But on repeating their experiments in other buildings where previous contamination could be excluded, they failed to induce tuberculosis by inoculation with any material other than tubercle, which they therefore regarded as containing a specific virus.

3. *Manner of introducing the exciting substance.*—Villemin inoculated the tubercle. He also succeeded by injecting a watery suspension of tubercle into the air-tubes. Feltz (1867) injected cheesy detritus into the right side of the heart, and produced, in the lungs, embolic nodules which underwent caseous degeneration. Injections into the left side of the heart caused similar changes in other viscera, especially the brain. Lebert and Wyss obtained the same results from injections into the veins. Sanderson injected the serous cavities. Chauveau (1868) found that infectious matters may be introduced into the body through the alimentary canal: he rendered calves tubercular by feeding them with small quantities of tubercle, or with muscle, milk, or sputa of a tubercular animal. Tappeiner succeeded in producing pulmonary tuberculosis in dogs by causing them to inhale phthisical sputum in a finely divided state. Lastly, Cohnheim and Salomonsen injected tubercular matter into the anterior chamber of the eye of rabbits. Tuberculosis of the iris developed, and was followed by infection of the cervical lymph glands, lungs, and other viscera.

4. *Lesions produced.*—The results of inoculation beneath the skin of guinea-pigs have been well described by Wilson Fox. (*a*) The material inserted becomes surrounded by dry cheesy stuff, which is shown by the microscope to consist of dried-up detritus, rather than true puriform cells. (*b*) Around the cheesy mass are a number of small round granulations, some transparent and some opaque, in size from that of a poppy-seed to that of a hemp-seed. These granulations consist of many nuclei, embedded in a homogeneous substance, together with some large epithelioid cells. (*c*) Indurated cords reach, beneath the skin, from the seat of injury towards—or to—the nearest lymphatic glands. These cords are sometimes cheesy in the centre. Microscopically they consist of strings or rows of cells and nuclei, like those of the granulations, contained in a limitary membrane. These cords are probably altered lymphatics. (*d*) The next change is found in the associated lymphatic glands. They are enlarged to twice or thrice their natural size, and are also apparently much increased in number—that is to say, very small glands become visible. On section, they look semi-transparent and confused in structure: scattered through them are spots and streaks of cheesy degeneration. The microscope shows a great increase in the number of the natural lymphoid corpuscles, and some larger epithelioid cells. (*e*) The lungs are next most frequently affected. They contain scattered granulations of different sizes, from the minutest speck to the size of a hemp-seed, or even larger; semi-transparent and firm, with a cheesy centre, sometimes softened. A distinct connexion with the air-tubes and vessels can often be made out, the granulations being seated in the peribronchial or perivascular sheath; but sometimes they have no particular relation to either. From these granulations proceeds an infiltration of the septa of the air-sacs; and concurrently with this change, the capillaries collapse and cease to be permeable by blood. The bronchial glands also are affected, in the same manner as described above. (*f*) The next most important changes are in the liver. It is much increased both in size and weight, in consequence of a diffuse infiltration of the capsule of Glisson and the tissue between the acini, with small corpuscles (such as before described) embedded in a fibrous network. The new tissue looks semi-transparent and glistering: scattered through it are spots of cheesy change. Here and there the lesion tends to assume the nodular form. The proper liver-cells degenerate and disappear. (*g*) The spleen is enlarged. Nodules, transparent or cheesy, and transparent diffuse infiltrations, are scattered through it. (*h*) In the agminated and solitary follicles of the intestines are sometimes found white or caseous nodules, or even ulcers. The stomach is unaffected. The lymphatic glands in the mesentery and in the hilum of the liver are usually affected. (*i*) Ascites is common, and probably due to the state of the liver and peritoneum. (*j*) In the omentum numerous granulations are often found, both around the small vessels, and also in the tissue where there are no vessels.

Sanderson found that when the serous cavities are injected with tubercle the membranes become studded, in two or three weeks, with granulations, small, but visible to the naked eye; and, for the most part, mere overgrowths of lymphadenoid tissue previously existing beneath the epithelium. The lungs undergo the change described by Wilson Fox, and also a pneumonic change, consisting in a filling of the air-sac with roundish cells, like those which are always found there in small numbers.

5. *Nature of the lesions.*—The great majority of pathologists were of opinion that these lesions, thus artificially produced in the lower animals, were the same as those which we call tubercular in man. On the other hand, Friedländer holds that these artificially produced nodules do not possess the structure of true tubercles, to which he holds a giant-cell to be essential. In his opinion, the nodules are nothing but disseminated chronic inflammatory nodules, with a disposition to caseate. He declares that in the lungs the lesion consists in nothing but miliary pneumonia, an assertion which is directly contrary to the experience of Wilson Fox and Sanderson. Sanderson classed tuberculosis among the infective inflammations, and regarded it as being closely allied to pyæmia. Cohnheim warmly adopted the theory that it is a specific infective disease, and recommended inoculation of animals as the only criterion of what is tuberculous, in view of the prevailing uncertainty as to the essential structure of tubercle.

6. *Characters of the virus.*—Villemin supposed it to be liquid, but almost all subsequent observers deemed it to take the form of minute solid particles. Thus Klebs, Aufrecht, Baumgarten, Schüller, and Toussaint succeeded in discovering different kinds of micro-organisms in tuberculous tissues, without adducing any convincing proof that the microbes were the cause of the disease. In 1882 Robert Koch announced the discovery by him, in tuberculous structures and in the sputa of phthisis, of the specific bacillus of tubercle. This is a thin motionless rod-shaped organism, in length from one-quarter to a-half the diameter of a human red blood-corpuscle.

Staining properties.—The tubercle bacillus differs from all other bacilli, except that of leprosy, in its behaviour to certain aniline dyes. When stained with fuchsin or methyl violet in combination with a watery solution of aniline oil, the bacillus takes up the colouring-matter rather slowly; but, unlike other microbes, with the exception of the leprosy bacillus, it resists the decolorising action of strong acids—nitric, sulphuric, hydrochloric, acetic. Tubercle bacilli thus stained appear as delicate red or violet rods, in which a faint beading is often visible. In the latter case the rod seems to be composed of a row or string of stained granules, which are believed to represent spores. The above method, devised by Ehrlich, differs from that originally employed by Koch, who stained the bacilli with an alkaline solution of methylene blue and decolorised with vesuvin. This process was not altogether satisfactory, and Koch quickly recognised the superiority of Ehrlich's method, which he himself adopted and recommended. Ziehl found that a watery solution of carbolic acid may be substituted for aniline water when fuchsin is used; and it is now generally admitted that Ziehl's and Ehrlich's solutions give equally good results. For further details of the process the reader is referred to the articles, MICRO-ORGANISMS; and SPUTUM, Examination of.

Distribution of the bacilli in the tissues.—The bacilli are most abundant in and among the epithelioid cells, and in the giant-cells, though they may also be found in varying numbers among the small round-cells, and in caseous masses. The same appearance and staining reactions distinguish the bacilli of tubercle, whether in man or in the lower animals.

Cultivation of the bacilli.—Cultivations were made from the following sources: In man, from miliary tubercle, sputum, and secretion from cavities in cases of phthisis, caseous pneumonia, scrofulous glands, tubercular testicle, fungous arthritis, and lupus. In the case of animals, from 'Perlsucht,' spontaneous tuberculosis in a guinea-pig, and caseous pneumonia in a hog; also from the organs of various animals which had been inoculated with tubercular matter. In all the cultures taken from these various forms of tuberculosis 'the bacilli behaved exactly the same.'

After numerous trials it was found that the microbe could best be grown on blood-serum sterilised and solidified by repeated heating. A minute portion of tuberculous tissue was spread over the surface of the solid serum in a suitable tube, which was then kept carefully at a uniform temperature of 37° to 38° C. (98·6° to 100·4° F.). 'Often-repeated experiments proved that at a temperature of 42° C. (107·6° F.) no growth occurs in the course of three weeks; and between 28° and 29° C. (82·4° and 84·2° F.) it ceases entirely.'

The growth of the bacilli thus cultivated is very slow, the first signs of increase appearing in ten to fifteen days, in the shape of tiny dry scales adhering loosely to the surface of the serum. These afterwards coalesce, to form a uniform thin coating. The cultures generally attain their maximum development at the end of four weeks; but after having been in existence for months, they can still be used for obtaining fresh crops of bacilli. From the first cultivation a second was started, and from the second a third, and so on for successive generations until a perfectly pure culture of the bacilli was obtained. As many as thirty-four generations were grown from one culture over a period of nearly two years.

Inoculation experiments.—Animals were inoculated with pure cultures in various ways, with the strictest antiseptic precautions, the bacilli being injected into the subcutaneous tissue, anterior chamber of the eye, abdominal cavity, and into veins. Lastly, the cultures were introduced into the respiratory passages in the form of a fine spray. With the exception of a few animals belonging to species only slightly susceptible to the disease, inoculation was invariably followed by the development of tuberculosis. Koch's experiments therefore demonstrated that a special bacillus is invariably present in tubercular lesions, that this microbe can be isolated and grown outside the animal body, and that inoculation of animals with pure cultures thus obtained causes tuberculosis. The tubercle bacillus was consequently proved to be the *vera causa* of the disease.

Full details of Koch's researches cannot be given here, but it may be added that he failed to cultivate the bacillus on potato, and he was only able to obtain a slight growth on nutrient agar-agar and in broth. Other observers were not so successful with Koch's method of cultivation. But Nocard and Roux discovered that a more rapid and luxuriant growth can be secured in nutrient agar to which a small quantity of glycerine has been added. They also obtained good results with chicken-broth, beef-broth, and Cohn's fluid, after the addition of glycerine. Crookshank succeeded in growing the bacilli in milk, sterilised urine, and nutrient gelatine containing 5 per cent. of glycerine. Paulowsky grew them on potato. Beevor found that a slow growth may take place on glycerine agar and on potato at 82° F., and in broth at even a lower temperature.

Koch instituted numerous control experiments with other pathogenic and non-pathogenic bacteria with similar antiseptic precautions, but in no case was tuberculosis induced. These results have been amply verified by Watson Cheyne and other careful observers.

Wilson Fox's experiments with setons and indifferent irritants were repeated, at his request, by Dr. Dawson Williams under modern antiseptic conditions, with the result that none of the animals contracted tuberculosis.

Histogenesis of Tubercle.—Koch inclined to the view that the epithelioid and giant-cells are derived from the migratory cells or leucocytes; and seeing that the bacilli have no power of locomotion themselves, he considered that transference of the microbes from one spot to another is due to active movement of the wandering cells, carrying the bacilli with them, after inclusion in their protoplasm. But the exact origin of the epithelioid and giant-cells was still a matter of inference only. In order to clear up this point, Baumgarten carried out an elaborate research on the development of tubercle in albino rabbits inoculated with pure cultures of the bacilli. The virus was introduced into the anterior chamber of the eye, where the early changes could be easily followed. Tuberculosis of the iris and other structures of the eye was succeeded in due time by a similar affection of the cervical lymphatic glands, lungs, and other organs. The histological changes were minutely investigated in the iris, cornea, lymph glands, lung, spleen, liver, kidney, bones, intestine, and peritoneum. But inasmuch as the details of the process are essentially the same in all the organs examined, tubercle of the iris may be selected as a convenient type.

The freshly excised iris was hardened by Flemming's method in a weak solution of chromic acid alone, or mixed with a certain proportion of osmic acid. No change could be detected with the microscope for five or six days after inoculation, but about this time the bacilli became incorporated with or closely applied to the fixed connective tissue and endothelial cells of the iris, which then commenced to proliferate. By means of the above method of hardening, combined with suitable staining, it was discovered that proliferation of the cells is preceded by the process of karyokinesis or karyomitosis—morphological changes in the nuclei shown by Strassburger and Flemming to occur preliminary to actual division (*see* Cell). The cells which evinced these nuclear changes always contained one or more bacilli. Karyomitosis was accompanied by swelling of the protoplasm of the cells, which gradually assumed the epithelioid type. Division of the nucleus and cell follows, and the result is a crop of young epithelioid cells, the offspring of the fixed cells of the tissue. Many of the new cells go through the same process of karyomitosis and division. Some of them have two or three nuclei, but at this stage no true giant-cells are seen. At a later period karyomitosis seems to be arrested when the epithelioid change has attained its full development. Now, for the first time, small cells or leucocytes, migrating from the vessels, begin to appear in increasing numbers at the margin of the tubercular focus. Baumgarten was unable to detect any karyomitosis in the leucocytes, and concludes that these take no part in the formation of the epithelioid or specific tubercle cells. The appearance of a reticulum is mostly confined to the periphery of the tubercle, and is regarded by Baumgarten as the result of a separation or fraying out of the pre-existing connective-tissue fibrils in consequence of the overgrowth of the cells lying in their meshes. The number of bacilli continues to increase, and the leucocytes gradually infiltrate the tubercle, hiding in part or altogether the original epithelioid cells, though careful examination with an oil-immersion lens and condenser will often discover the presence of epithelioid cells in what at first sight appears to be a simple small-celled tubercle. Regressive changes now set in; the leucocytes undergo molecular disintegration, and break up into granular masses. The nuclei of the epithelioid cells no longer take the stain, the protoplasm shrivels up, the cells become partially fused together and are transformed into indistinct non-nucleated epithelial scales containing tubercle bacilli. Gradually the necrotic process extends from the centre to the periphery, all cellular structure is lost, and the nodule is converted into a granular caseous mass teeming with bacilli. If giant-cells develop at all, it is only in the latest stages. The above description refers to animals inoculated with virulent cultures swarming with bacilli. If less active cultivations or 'Perlsucht' nodules containing relatively few bacilli be used, the process is somewhat different. The reaction of the tissues is more chronic and less intense. The formation of epithelioid cells is succeeded by the development of typical giant-cells containing bacilli, whereas the invasion of leucocytes occurs much later and is a comparatively insignificant feature in the process. The microscopical appearances in this case closely resemble those met with in chronic tubercular affections in man. In the tubercular lesions of other organs karyomitosis and cell-proliferation are manifested not only by the connective-tissue elements, but also by glandular and epithelial cells, and by the endothelium of blood and lymphatic vessels. Baumgarten holds with Koch and others that the giant-cells of tubercle are formed from individual cells, not by fusion of several cells; but he was not able to detect karyomitosis in the giant-cells. The localised lesions known as pseudotuberculosis of animals, excited by indifferent foreign particles, were also investigated; and it was shown that, although the nodules may be composed of epithelioid and giant-cells, they never contain tubercle bacilli, and do not caseate—that is to say, they are not tuberculous.

These observations have greatly elucidated the histology of tuberculosis, and enable us to reconcile some of the conflicting statements of earlier writers. Thus the epithelioid and giant-celled tubercle of Langhans and Schüppel, and Virchow's small-celled lymphoid tubercle, are seen to represent different stages of development of the same growth. The lymphadenoid character of tubercle can no longer be maintained. The epithelioid cell, the product of the proliferation excited by the bacillus, must be regarded as the special cell of tubercle, as Rindfleisch long ago maintained. A fresh light has been thrown on many obscure questions of pathology by the researches of Koch and his followers. The caseous transformation, which plays so important a part in the process, has long been a difficulty, but Watson Cheyne suggested, what is highly probable, that it is the result of some poisonous chemical substance generated by the bacillus. The special proclivity to tuberculosis manifested by lymphoid structures is now seen to depend on the fact that the bacilli, so frequently entering the body through lymphatic spaces, are first arrested in corresponding lymph follicles or glands, and there is no longer any necessity to invoke the hypothesis of a special diathesis of tissue.

Dissemination of the disease in the body is the consequence of the entry of the microbes into the blood.

The pulmonary veins and the thoracic duct have been shown by Weigert and Ponfick to become involved in the tubercular process in certain cases. The former is by far the more common and important channel of infection, and the bacilli have been found in the walls of small arteries and veins by Koch and others. The passage of bacilli from diseased lymphatic glands into the thoracic duct and subclavian vein is another very common means by which diffusion of the disease is effected. The acute development of general tuberculosis is probably determined by the sudden discharge of large numbers of the bacilli into the circulation.

The diathesis of organs admits of a natural and simple explanation. The lungs are so often attacked because, as Koch points out, the bacilli are commonly introduced through the air. The spread of tuberculosis through the lungs is mainly due to inhalation of bacillary secretion from cavities into distant bronchioles; but local extension by lymphatic paths also plays an important part. The intestines are generally infected by swallowed sputum, the stomach escaping in consequence of the protective action of the acid gastric juice, not because of the small amount of lymphoid tissue in its walls.

The frequent implication of the spleen, pia mater, and kidney in cases of general tuberculosis is partly, and probably mainly, to be explained by the intricate arrangement of the circulation in these parts, favouring the occurrence of bacillary embolism. But the comparative immunity of organs like the pancreas, ovaries, and thyroid gland has still to be accounted for. The long-continued localisation of the tubercular process so often witnessed in the lymphatic glands, bones, joints, and other parts of the human body cannot yet be completely explained, though the small number of bacilli found in such lesions accords well with the chronicity of the disease. Possibly in these very chronic forms the lymphatic vessels of the part become blocked with caseous and other products, and thus extension is hindered. The occurrence of primary tuberculosis of deeply seated organs like the kidney, joints, and bones is believed by Koch to depend on arrest in the capillaries of single infective germs. How these enter the blood is somewhat uncertain, but it may be, as Koch hints, that in many instances the primary origin of the disease in these localities is apparent only, infection being the result of an undetected tubercular bronchial or other lymphatic gland. The arrest of tubercular disease is attributed by the same author to some alteration in the conditions of growth of the bacilli taking place in the human body. The solution of this question involves the explanation of immunity; but whether this be due primarily to phagocytosis or to chemical action of animal juices is still a matter of dispute. It seems not impossible that arrest may be to some extent the consequence of local inflammatory and other conditions favouring encapsulation of tubercular foci. *See* Immunity.

Ætiology.—Without the presence of the tubercle bacillus there can be no tuberculosis. From this central point all ætiological inquiry must start. In the early days of Koch's discovery it was generally assumed that the bacillus is ubiquitous, and that everyone is constantly being exposed to its influence. Recent researches have thrown doubt on this assertion. The inhalation experiments of Tappeiner, Koch, and others have demonstrated the possibility of tubercular infection taking place through the medium of the atmosphere, and the fact that in man the lungs are affected more frequently than any other organ suggested to Koch that this is the route by which the virus commonly enters the body.

Pulmonary tuberculosis must, without doubt, be regarded as the source from which the bacilli are derived in the great majority of instances, owing to the fact that swarms of these microbes are constantly being discharged with the sputum. When allowed to dry on floors, pocket-handkerchiefs, clothing, bedding, &c., the sputum is liable to become pulverised, and is then easily carried about by currents of air, and inhaled into the air-passages and lungs of other persons. Experiments by Koch and his pupils have proved that dried tubercular sputum retains its virulence for months; hence the danger of infection lasts long after the sputum has been expelled from the lungs. It may be taken as a well-established fact that the bacilli are not exhaled from the lung in the free state, though they may be ejected with small particles of mucus by violent coughing. Attempts to discover them in the air have been unsuccessful. Recognising the fact that all bacilli are relatively heavy bodies, and therefore tend to sink in the air and to adhere to foreign particles, Cornet proceeded to investigate the deposits of dust in various localities in Berlin. His method consisted in the inoculation of animals with dust collected from the walls of hospitals, prisons, asylums, and private houses, and from the public streets. The dust was collected with a sterilised spatula or sponge, and was thoroughly mixed with sterilised broth. The fluid was then injected into the peritoneal cavity of guinea-pigs with strict antiseptic precautions. Many of the animals died rapidly of septic peritonitis; a few remained in good health, and, when killed after an interval of two months, were found to be free from tubercular disease. Lastly, in a certain number of instances the animals developed tuberculosis. As the result of his researches, Cornet found that the presence of the tubercle bacillus could frequently be demonstrated by inoculation experiments in the dust of rooms inhabited by phthisical patients; but that where the inmates had not been tubercular no evidence of the virus could be discovered. Further details of this interesting and important investigation cannot be given here.

Accidental inoculation of a wound or abrasion of the skin of a healthy person with tubercular sputum has been known in more than one instance to cause tuberculosis. It has been thought that house-flies may act as carriers of the virus.

The question of contagion between husband and wife has been much discussed; but, though there can be no doubt that contagion does at times occur, infection can with more probability be attributed to inhalation of dried sputum. Instances of direct inoculation of the genito-urinary apparatus are rare, whereas tuberculosis of this system is comparatively common in both sexes. The marked liability of the abdominal organs of children to tubercular affections points to the entrance of the virus through the alimentary canal, and attention has been specially directed to milk, the main article of diet of young children. Cows are known to be very prone to a chronic form of tuberculosis, 'Perlsucht,' in which the lungs and other viscera are involved, but the mammary gland itself is not very often diseased. The flesh of animals disposed to tuberculosis, such as oxen, swine, and poultry, is another possible source of infection, when insufficiently cooked; but the ætiological importance of milk and meat has yet to be precisely defined.

Although it is no longer doubtful that tuberculosis depends on the invasion of the bacillus, the conditions necessary for the development of the microbe in the human body are still imperfectly known. The anatomical arrangements of the nose, pharynx, and larynx, coupled with the ciliary movement of the epithelial cells lining the respiratory tract, are eminently adapted to arrest fine particles of any kind on their way towards the lungs, and to promote their extrusion from the body. The extreme rarity of primary tuberculosis of the upper air-passages lends indirect support to this statement. Again, the slow growth of the bacilli must operate against their chances of taking root wherever they may be deposited. Furthermore, it is probable that the amount of tubercular dust inhaled is usually very small, and infection must be, to a great extent, a question of dose. The vital resistance of the body, whether it be exercised by its cells or fluids, must be impaired by debilitating influences of various kinds. Insufficient food and sunlight; overcrowding; imperfect ventilation; noxious trades, especially those associated with much dust; frequent pregnancies; hyperlactation; exhausting diseases like diabetes; pleuritic adhesions, and local conditions affecting the thoracic walls; diseases of the respiratory organs, more particularly those associated with influenza; feeble ciliary action; defects in the epithelial lining of the respiratory tract, supposed to occur in measles, whooping-cough, and scarlatina—all these are probably concerned, in varying degrees, in the production of a certain predisposition to tuberculosis.

Heredity. — Tubercular Diathesis. — The fact that tuberculosis so commonly affects many persons in a family was always regarded, till recent times, as a sufficient proof of the strongly hereditary character of the disease; but Koch's discovery has led some writers to minimise the importance of heredity, and to ascribe an almost exclusive influence to the bacillus. The exponents of this view would explain the occurrence of tubercular disease in a family by the opportunities of infection which arise when one member is attacked. If we except the very rare cases of congenital tuberculosis, we may assert that the bacillus is not communicated by the parents to the fœtus—that is to say, the disease itself is not inherited. But there are no facts contradicting the belief that a certain vulnerability or disposition to tuberculosis is transmitted from one generation to another. In this restricted sense we may unhesitatingly affirm the existence of a tubercular predisposition or diathesis, without denying that many cases of family phthisis are really the outcome of family infection. Tubercular disease manifesting itself in the kindred of a person suggests the probability, though it is no actual proof, that the person akin possesses the same diathesis. The recognition of the diathesis in the person himself is fraught with difficulty. In the first place, a special conformation of body, or 'tubercular habit,' cannot be discovered in most cases; and, secondly, many of the symptoms of scrofula, supposed to indicate a predisposition to tubercular disease, are in themselves a positive proof that the patient is already tuberculous (*see* Scrofula). No age is exempt from the disease, but it is especially common from the fifteenth to the twenty-fifth year. The belief is gaining ground that it is far less rare in infants than was formerly assumed. It is certainly not very uncommon in advanced life. The two sexes are almost equally affected. Tuberculosis is a disease of civilisation, and is to be found in all populous communities, without much regard to conditions of climate or soil.

Prophylaxis. — This topic can only be alluded to very briefly. Recognising that tubercular sputum is a source of infection, our efforts must be directed to its disinfection or complete destruction. When large fires or furnaces are available, as in hospitals, the sputum should be burnt. In other cases, it may be treated with suitable disinfectants and discharged into the drains. The sputum must on no account be allowed to dry, and should be received into suitable earthenware spittoons, containing carbolic acid solution (1 in 20). Patients should be instructed not to expectorate into handkerchiefs, owing to the possibility of the dried sputum becoming diffused in the air. Contamination of clothing, bedding, carpets, must be guarded against. All body-linen and woollen articles should be boiled, or otherwise disinfected, before they are sent to the laundry. Rooms that have been inhabited by bedridden patients should be disinfected.

Meat ought to be well cooked, and all milk must be boiled, especially if intended for the use of children. If the disease is suspected, marriage should, if possible, be postponed. In the case of husband or wife becoming affected, clear and simple instructions should be given as to the precautions necessary, and it should be explained that the sputum constitutes a danger. In delicate persons and in children, more particularly after such diseases as measles, whooping-cough, influenza, and typhoid fever, all catarrhs, however trifling they may seem, require careful treatment. In addition, the general rules of personal hygiene must be enjoined in such cases.

S. J. Gee.
Percy Kidd.

TUBERCULAR ERUPTIONS. — This term is applied to eruptions consisting of small prominences of the skin. The use of the expression is somewhat arbitrary, inasmuch as a small tubercle would fall under the denomination of 'pimple,' and a large tubercle under that of 'tumour.' It is also objectionable on account of its double meaning. Willan defines tubercle to be 'a small, hard, superficial tumour, circumscribed and permanent, or suppurating partially.' In this definition prominence and bulk alone are regarded; and, as a consequence, in his group of tubercular eruptions of the skin, Willan brings together an incongruous assemblage of superficial growths, wholly discordant in their nature, some being grave and some only trivial, and of which the greater part can only be dealt with under their separate heads. For example, he enumerates as members of this group: 'phyma, verruca, molluscum, vitiligo, acne, sycosis, lupus, elephantiasis, frambæsia;' and omits altogether that very important group of tubercular eruptions which are due to syphilis.

Erasmus Wilson.

TUBERCULAR MENINGITIS.—A form of meningitis dependent on the presence of tubercle. *See* Meninges, Cerebral, Diseases of.

TUBERCULAR PHTHISIS. — A synonym for pulmonary consumption associated with tubercle. *See* Phthisis; Tubercle; and Tuberculosis.

TUBERCULOSIS.—Synon.: Fr. *Tuberculisation*; *Tuberculose*; Ger. *Tuberculose*; *Tuberkelbildung.*—By tuberculosis is meant the production of tubercle. The anatomical and ætiological aspects of tuberculosis are discussed in the articles on Scrofula and Tubercle. The present article is devoted to the semeiotic aspect of tuberculosis; that is to say, to the signs whereby we discover the tubercular process in the living man.

We lay down two prime distinctions at the outset. First, although tubercle tends to be disseminated more or less widely, yet it commonly affects some one organ more than the rest, so that during life this organ alone seems to suffer. Wherefore tuberculosis is distinguished according to the organ most affected, a rule to which there is but one exception—namely, the form of tuberculosis which does not predominate in any part, which is a disease of the whole substance, which resembles typhus or enteric fever, and which will be described presently. Secondly, tuberculosis is acute or chronic; words which we take in their common meaning, without further definition.

In the article on tubercle will be found a list of the organs prone to tubercle. The signs of the corresponding local forms of tuberculosis are described in the appropriate articles. We speak of tubercular pleurisy, peritonitis, pericarditis, meningitis; tubercular disease of the fauces, of the intestines, of the larynx; pulmonary tuberculosis or phthisis; tubercle of the kidneys, of the genito-urinary passages; of the lymphatic glands, of the suprarenals, of the testicles, of the brain, of the skin, of the choroid, and of other parts.

Tuberculosis tends to be chronic. But some of its forms are acute, specially tubercular meningitis, tubercular pericarditis, acute pulmonary tuberculosis, and the typhoid disseminated form of the disease.

Acute typhoid tuberculosis.—The signs of this disease may be summed up thus: Fever, and the usual attendants thereof; without signs of local inflammation, or of typhus or enteric fever. Marked by the thermometer, the fever is not high, seldom rising above 103°. The face devoid of expression, pale or dusky. The patient heavy, loth to be disturbed, but answering to the point. Sleep disturbed; much dreaming. Progressive emaciation. Skin dry and harsh; no eruption. Tongue dry, sordes on teeth, thirst. Belly not distended; spleen large. Nausea, vomiting; bowels costive and stools pale, or temporary looseness with yellow stools. Frequent short cough; no expectoration; no physical signs of disease in chest, except, perhaps, of slight catarrh. Pulse frequent and weak. Urine high-coloured. In a case such as this, probability would become certainty if tubercles were discovered in the choroid. Trousseau says that headache more or less severe, and delirium more or less violent, may be present.

The onset is somewhat sudden; the duration, from three to six weeks; and the termination, death. We may suppose that slight forms of the disease end in recovery; but proof is difficult or well-nigh impossible.

Treatment.—The treatment of acute tuberculosis is the same as that of any severe fever; for instance, typhus. *See* Phthisis.

S. J. Gee.
Percy Kidd.

TUBULAR. — A peculiar quality of sound, indicated by the name, either elicited by percussion, or heard on auscultation, in certain conditions. *See* Physical Examination.

TUMOURS.—Synon.: Fr. *Tumeurs*; Ger. *Geschwülste.*

Definition.—In the broadest sense of the word, a tumour signifies *a swelling*, and must therefore include conditions so far apart as a phantom-tumour, a hypertrophied muscle, an abscess, a hernia, or a cancer; but in its more restricted sense its application is confined to *a swelling caused by some form of new-growth.*

Classification.—The separation of new-growths into benign and malignant, though very useful as an approximate clinical distinction, is not admissible in a scientific discussion. Nor again is one that is founded upon the seat or shape of the tumour sufficiently accurate for the purpose. This arrangement would involve such antiquated terms as parenchymatous or superficial, nodules, infiltrations, fungus-growths, &c. The true classification must depend upon the actual structure, that is, the microscopical characters of the growth. Such a classification is the following:—

A. **Tumours composed of a normal tissue of the adult human body, or of such a tissue very slightly modified.**—(1) Fibroma, hard and soft, including Cheloid; (2) Lipoma; (3) Chondroma; (4) Osteoma; (5) Papilloma (warts and corns); (6) Adenoma; (7) Lymphoma; (8) True myoma, including Myo-fibroma; (9) True Neuroma; (10) Angioma; and (11) Lymphangioma.

B. **Tumours consisting of some modification of embryonic connective tissue,** that is, the *Sarcomas.* (1) Round-celled sarcoma, including Glioma; (2) Oval-celled sarcoma; (3) Spindle-celled sarcoma, large and small; (4) Alveolar sarcoma; (5) Mixed sarcoma; (6) Myeloid sarcoma; (7) Myxoma; (8) Osteo-sarcoma; (9) Chondro-sarcoma; (10) Melanotic sarcoma; (11) Fatty sarcoma; and (12) Psammoma.

C. **Tumours consisting of a modification of epidermic, epithelial, and secreting-gland structures.**—(1) Cancers; and (2) Rodent ulcer. These forms of new-growth are described in special articles. *See* CANCER; and RODENT ULCER.

D. **Tumours consisting of an inflammatory growth.** — (1) *Simple.*— Granulation-tumours, Osteophytes, &c. (2) *Specific.*— Depending on the presence of syphilis, tubercle, struma, leprosy, glanders, actinomycosis, and other parasitic organisms. The inflammatory tumours included under this class do not come strictly within the scope of the present discussion; its various sub-divisions must be sought under the description of the diseases which give rise to them, in the several articles bearing their respective names.

E. **Cysts.**—This division is also dealt with in a separate article. *See* CYSTS.

A. **Tumours composed of a normal tissue of the adult human body.**— In this class are included representatives of each of the primary tissues of the adult body. The members of it, therefore, differ widely in structure and appearance; but they are distinguished from those of the second and third classes by one important feature, namely, that, though often multiple, they show little or no tendency to return after complete removal—that is, they are essentially *benignant.* To this may be added another less characteristic distinction, namely, that they have but little tendency to ulcerate; and that, as a result, if they interfere with life at all, it is by pressure on important organs, or in such an accidental way as by the bleeding which may result from a uterine fibroid, rather than by the production of direct constitutional disturbance.

1. **Fibromata.**— DEFINITION.—Tumours consisting simply of fibrous tissue or some modification of it.

VARIETIES, CLINICAL CHARACTERS, AND MICROSCOPICAL APPEARANCES. — Fibromata may be divided into *hard* and *soft fibromata.*

(*a*) *Soft fibrous tumours.*—The soft fibromata are simple masses of connective tissue, occurring in the submucous or subcutaneous structures, and generally, but not always, more or less pedunculated. In many cases there are overgrown papillæ on the surface; and overgrown and distorted glands of the skin or mucous membrane are often entangled amongst the meshes of the tumour. The *subcutaneous* variety occurs in all parts of the body, but is perhaps most common in the labia majora and the lower limbs; and to it the name of *molluscum fibrosum* has been applied. These tumours often contain a considerable amount of fat, and thus approach the lipomata. They often appear œdematous; and may undergo calcareous or other forms of degeneration. The *submucous* variety includes the simple polypi of the nose and, if such occur, of the middle ear. In these the fibrous tissue is somewhat modified; the ordinary connective-tissue cells, oval, oat-shaped, or branched, being embedded in a more or less copious gelatinous (? mucous) matrix. Such tumours are nearly related, on the one hand, to the myxomata, and are covered by a mucous membrane corresponding to the region in which they occur—ciliated, for example, in the nose (fig. 161), and columnar in the intestine. On the other hand, they often contain in their interior the characteristic glands of the part they affect, and thus approximate to the adenomata. To the naked eye they have a gelatinous appearance. The reader will observe that the varieties of *elephantiasis,* a disease which presents a complex structure, are not included under this heading.

(*b*) *Hard fibrous tumours.*—These tumours are made up of pure fibrous tissue, but it is very difficult to draw the line between them and some forms of sarcoma. They are firm, usually encapsuled, and often pedunculated. To the naked eye a section is white or pinkish, and presents an appearance as if its component parts were arranged concentrically round a number of points. This appearance is more marked on microscopic examination, which, while it shows this concentric arrangement in bundles that have been cut across, exhibits others which have been divided longitudinally (*see* fig. 160). Hard fibromata occur in many situations: in the subcutaneous tissue, including amongst others the cheloid tumours, the fibrous tumours of the pinna, which are sometimes caused by the piercing of the ears for ear-rings, or may result from the hæmatomata not infrequently met with in idiots, and some, at least, of that peculiar class of tumours called 'the painful subcutaneous tubercle'; in submucous tissues, including many of the naso-pharyngeal polypi, and some of the fibrous tumours and polypi of the uterus; in connexion with the periosteum, including the fibrous epulis, which probably often starts as a myeloid, the so-called fibrous tumours of bone, and, according to some authorities, though this is doubtful, some kinds of subungual exostosis; in nerves, including the common neuromata, and bulbous nerves in a stump; and in the intermuscular planes. They are liable to various forms of degeneration; they often calcify; and those in connexion with the periosteum may undergo ossification. Some fibrous tumours cause serious danger to life from the position they occupy; it will be enough to cite the cases of naso-pharyngeal polypi, and polypi of the uterus.

Treatment. — Fibromata can only be treated, if interference of any kind be necessary, by complete removal, the nature of the operation depending upon the position of the growth. If completely removed, they have no tendency to recurrence.

2. **Lipoma.** — Definition. — A tumour composed of normal adipose tissue.

Varieties and Clinical Characters. — Occasionally more or less local hypertrophies of the subcutaneous fatty layer occur, and merit almost the designation of a tumour; but the true lipoma is a pretty well-defined tumour, made up of a larger or smaller number of overgrown fat-lobules. These are sometimes of enormous size, so that only two or three are found in a tumour of considerable dimensions. The skin presents a very characteristic dimpling, when moved to and fro over such a subcutaneous fatty tumour. The superficial parts of the mass may generally be easily separated from the surrounding structures during an operation for its removal; but the deeper parts, often consisting of smaller lobules, and generally containing a vessel of some magnitude, require more careful enucleation. Fatty tumours are met with in all parts of the body in which adipose tissue is normally developed. The writer once met with a fatty tumour inside the spinal column. They may occur congenitally, but are more common in middle and advanced life. They are often multiple, and are apparently in some cases developed as the result of pressure; and sometimes they are remarkably symmetrical. They involve no danger to life, but are often very painful, as the result of pressure upon cutaneous nerves. Microscopically, the structure is that of ordinary adipose tissue.

Treatment.—Though fatty tumours are said to shift their position, and sometimes to diminish in size spontaneously, they are not to be dispersed by internal remedies or external applications. If necessary, they must be removed by the knife, an operation which, as already mentioned, is usually easy. It is to be observed that recurrence may take place unless they be completely removed.

3. **Chondromata.** — Definition. — Tumours made up altogether, or in great measure, of cartilage.

Varieties, Course, and Clinical Characters.—Cartilage-tumours may be divided into those which grow in connexion with a *bone*; and those which are developed in the *soft parts.*

Cartilaginous tumours growing in connexion with bone.—These may be again subdivided into those which grow from the surface of the bone—*ecchondromata*; and those which grow from the interior—*enchondromata.* The latter are the simplest form of cartilage-tumours; they commence usually during the period of adolescence, and affect by preference the fingers and toes, but are occasionally found elsewhere; they are almost always multiple, but never show a malignant tendency; they may reach a very considerable size; and they are generally coated with a thin layer of bony tissue. The *ecchondromata* are developed, as a rule, during a later period of life; are found in connexion with any of the bones of the body; and often attain an enormous size, as, for example, in the pelvis. Some of these tumours, to which Virchow has given the name of *osteoid chondroma,* such as are occasionally found forming elongated swellings in the shaft of a long bone, present a high degree of malignancy, recurring as such in distant parts of the body.

Cartilaginous tumours of the soft parts.—These tumours occur principally in connexion with certain glands, and especially in the neighbourhood of the parotid, and in the testicle. It has been suggested that they may originate from some remains of fœtal structures. Rarer situations for such tumours are the submaxillary gland, the breast, the ovary, the lacrymal gland, the kidney, and, it is said, the lung. These tumours are comparatively seldom pure, but are usually mixed with myxomatous, adenoid, or sarcomatous structure; the degree of such admixture determining in great part the benignness or malignancy of the growth.

An account of the so-called *ossifying chondromata* is given under heading 4.

Naked-Eye Appearances.—Cartilaginous tumours vary very much in density; the hardest contain fibrous tissue, and are, in fact, fibro-cartilaginous growths; the softest are very soft, and are very closely related to the myxomata; indeed, it may be held that many myxomata are merely varieties of chondroma. Some chondromata soften, either in many parts or in the centre, giving rise to one or more cysts in the interior; the bursting of such may lead to a permanent sinus. Other forms of degeneration are not uncommon, and especially calcification. True ossification is not rare.

Microscopical Characters.—Microscopically the structure often differs widely in different specimens of chondroma, and in different parts of the same tumour; the matrix may be hyaline or fibrous; and the cells

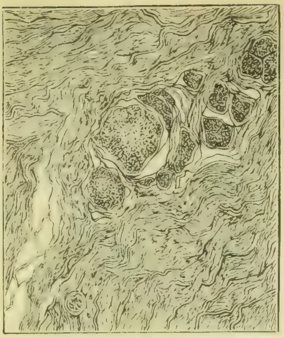
FIG. 160. Fibroma (Neuroma).

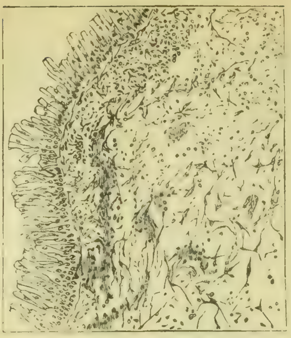
FIG. 161. Polypus of Nose.

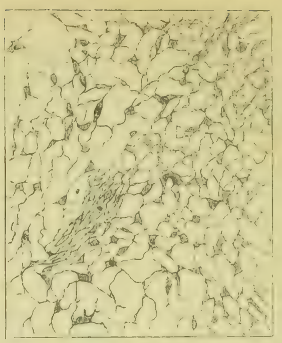
FIG. 162. Myxoma.

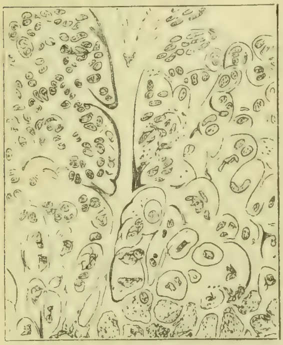
FIG. 163. Ossifying Chondroma.

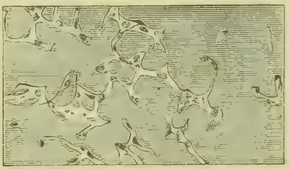
FIG. 164. Enchondroma (of Jaw).

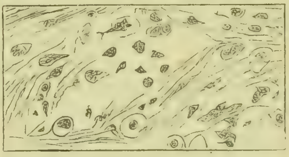
FIG. 165. Enchondroma (of Orbit).

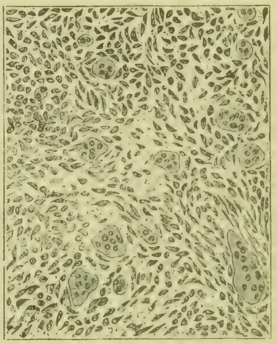
FIG. 166. Myeloid of Jaw.

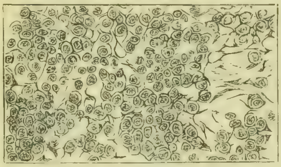
FIG. 167. Large Round-celled Sarcoma.

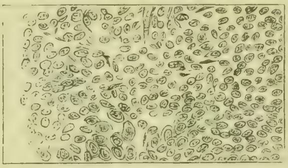
FIG. 169. Oval-celled Sarcoma.

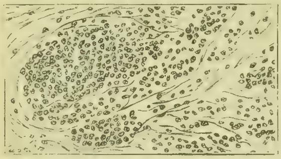
FIG. 168. Small Round-celled Sarcoma.

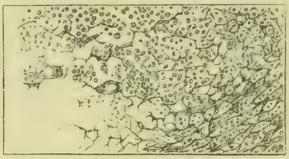
FIG. 170. Lymphoma.

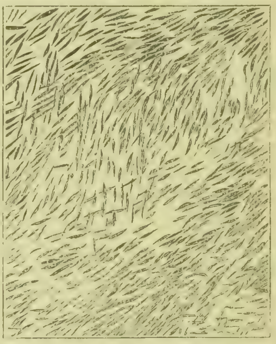
FIG. 171. Small Spindle-celled Sarcoma.

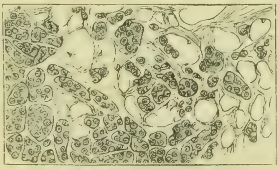
FIG. 172. Alveolar Sarcoma.

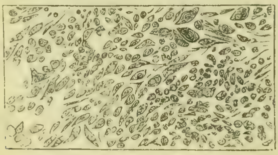
FIG. 173. Mixed Sarcoma.

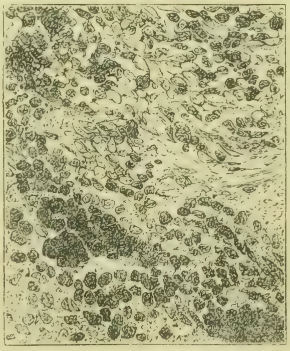
FIG. 174. Melanotic Sarcoma.

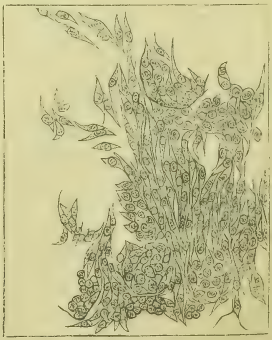
FIG. 175. Large Spindle-celled Sarcoma.

Drawings illustrating a Series of Tumours of the Connective-tissue Type.
All drawn to the same scale (× 87 diameters).

round, irregular, stellate, or much-branched (figs. 164 and 165). It will easily be understood that with a soft hyaline matrix and much-branched cells, the appearance of myxoma is very closely simulated.

TREATMENT.—Bearing in mind the great variety of these tumours, it will be seen that it is impossible to sum up the treatment of them in a few words. The simple enchondromata of the fingers should only be removed to cure deformity or similar inconvenience. As a rule, other forms should be removed as early as possible; but many chondromata spring from regions which are altogether beyond the reach of the surgeon's knife.

4. **Osteomata.**—DEFINITION.—Tumours composed of bone.

VARIETIES.—If the inflammatory exostoses be excluded, such as those which are found round a joint affected with chronic rheumatic arthritis, or those which depend upon the ossification of a node, or of inflammatory products in the external auditory meatus, we may divide this class of tumours as follows:—

(*a*) Osteomata developed as such on the exterior of a bone, including the ivory exostosis—*periosteal exostoses.*

(*b*) Osteomata developed as such in the interior of a bone—*enostoses.*

(*c*) *Pedunculated exostoses.*

(*d*) Osseous tumours of *the soft parts.*

(*e*) Osseous tumours produced by the *ossification of other kinds of new-growths.*

(*f*) And lastly (though not strictly coming under the same category) the *odontomata.*

(*a*) *Periosteal exostoses.* — These are irregular bony tumours, appearing usually in adult life; they are directly continuous with the bone from which they spring; and are composed sometimes of cancellous structure, with a thin coating of compact tissue, but much more frequently of denser material. They most often affect the bones of the face, where they produce horrible and distressing deformities; but are also found on the skull, in the meatus of the ear, or, more rarely, on the long bones. From the importance of the neighbouring structures it is, in most cases, impossible to remove them, but where it is possible and advisable, as for example in the ear, they should be removed with the gouge and hammer, or by means of a drill. Some of these tumours are of extreme density, and have hence been called *ivory exostoses*; these, when they affect the upper jaw, their commonest seat, must be distinguished from the *odontomata,* to be presently described.

(*b*) *Enostoses.*—Enostoses need only be mentioned in order to point out their extreme rarity; but it may be remarked that many of the last-described series of tumours probably spring from the diploë of the cranial bones, and should thus, perhaps, more properly be included under this heading.

(*c*) *Pedunculated exostoses.*—The pedunculated exostosis, or ossifying chondroma, is a subperiosteal chondroma, with a tendency to ossification, developed in young people, near the junction of an epiphysis with a diaphysis.

Pedunculated exostoses approach the spherical shape, but are sometimes irregular or flattish, and often tuberculated. The peduncle varies in its relative size, the growth being often nearly sessile. On section the tumour shows a layer of periosteum superficially; beneath this is a layer of cartilage, sometimes thick, sometimes almost imperceptible. The deeper part of the cartilaginous layer is calcified, and looks like imperfectly formed bone. The centre of the tumour consists of true bone, with Haversian systems complete, and is directly continuous with the tissue of the bone itself. The cancelli are sometimes dilated so as to form actual cysts containing clear fluid. In adult life the layer of cartilage disappears, and the tumours cease growing.

The microscopical appearance answers exactly to the structure which is apparent to the naked eye (fig. 163).

These tumours occur most often near the ends of the long bones, but may be found elsewhere; on the scapula, for example. They are often multiple and symmetrical, and if multiple are frequently hereditary. In certain situations, as, for instance, on the inner side of the knees, they may cause much inconvenience, from the pain produced by pressure as in riding, or from the catching and sudden slipping over the tumour of tendons or other fibrous structures in the neighbourhood. For this reason, or from their size, they may require removal. This may be done freely if antiseptic precautions be adopted; otherwise the opening of the cancellous structure of the bone, and the danger of wounding the contiguous joint, may perhaps involve greater risk than the amount of inconvenience entailed by the tumour would justify. They have sometimes been either purposely or accidentally separated from their attachment by a blow, without inflicting a wound on the soft parts at all. Unless the whole cartilage-layer be removed, recurrence will probably happen, as growth of the tumour takes place by increase of this layer only, the process of calcification and subsequent ossification being secondary and, so to speak, accidental.

(*d*) *Osseous tumours of the soft parts.*—These osteomata are also uncommon. They include such conditions as the following: tumours springing from the periosteum, but not actually united to the bone; ossifying chondromata not connected with the bone; detached exostoses; ossification taking place in muscles or tendons, such as that which is occasionally met with in the adductor longus; and perhaps some other varieties of greater rarity.

(*e*) *Osseous tumours produced by the ossification of other kinds of new-growths.*—These are only secondarily, and often only partially, worthy of the name of osteomata; they are the result of a process of ossification taking place in tumours of a different nature originally, such as fibromas or sarcomas. It must be remembered that, while calcification of new-growths is a common form of degeneration, the occurrence of true ossification is very rare.

(*f*) *Odontomata.* — Odontomata are tumours composed of one or more of the constituents of the teeth. The simplest variety consists of a sort of exostosis from the fang. These are usually of small size, and may extend from one tooth to another. Such tumours are composed altogether of cement. The other kind is more or less covered with enamel, and contains dentine and cement in varying proportions; these, the true odontomata, may sometimes attain a very considerable size. They are only found in connexion with the jaws.

5. **Papillomata.** — DEFINITION. — Papillary and villous over-growths, whether occurring on the mucous membrane, skin, or serous membrane, which do not present malignant characters.

VARIETIES AND SYMPTOMS.—Mucous papillomata are found on the lips, tongue, and soft palate, and in the larynx; in the intestines, especially at the lower part; round the anus (condylomata); in the bladder (the simple villous tumour); on the conjunctiva; and at the orifice of the female meatus urinarius. Epidermic papillomata include warts and corns, and may occur on any part of the skin; those about the external genitals may reach an enormous size, and are frequently the result of gonorrhœa. The serous and synovial papillomata are more rare; under this class must be named the Pacchionian bodies, and the enlarged synovial fringes which are often the commencements of loose bodies in joints. Many papillomata are of syphilitic origin; others may be caused by local irritation, as, for instance, the cadaveric wart, in which the papillary growth is accompanied by inflammation and suppuration beneath the skin. But with regard to the last-named affection it must be added that recent observations point to its dependence on, or constant association with, the presence of the tubercle bacillus.

NAKED-EYE APPEARANCES. — The naked-eye appearances vary very much with the locality in which the growths are developed; but they present this character in common, that they are obviously composed of the papillæ or villi of the part from which they grow, though these may be of much more than the natural size. Those springing from mucous and serous membranes are soft, and usually moist on the surface; while epidermic papillomata are dry and hard.

MICROSCOPICAL CHARACTERS.—Microscopically papillomata are made up of connective tissue containing numerous vessels, covered by the characteristic epithelium or epidermis of the part (fig. 7, vol. i. p. 270). The arrangement of the connective tissue and epithelial elements is a close imitation of that of the normal tissues from which they grow. The microscopical structure of the benign polypus of the intestine (fig. 10, vol. i. p. 270) is hardly to be distinguished from that of many malignant growths in this situation. *See* CANCER.

TREATMENT.—If affecting the larynx or bladder, papillomata may give rise to distressing and dangerous symptoms, and may necessitate severe operations for their extirpation. Those which occur on accessible parts are generally removed without any risk, except such as arises from their great vascularity; and show, as a rule, but little tendency to recur after complete removal. The common wart, however, often gives great trouble. Various caustics may be used, such as the acid nitrate of mercury, fuming nitric acid, caustic potash, acetic acid, or nitrate of silver; salicylic acid is also often extremely useful; but while these remedies are sometimes efficacious, the warts will often recur with the greatest possible inveteracy. At the same time it must be remembered that they frequently show a most capricious tendency to spontaneous cure; the surgeon will sometimes be mortified at finding that while his energies have been devoted with but partial success to the cure of one or two out of an extensive crop of these growths, the remainder have, in the meantime, spontaneously disappeared. The cadaveric or dissecting-room wart is best treated in the early stages by soothing applications, and may perhaps be cured by the external use of belladonna; should this, however, prove unsuccessful, the employment of a powerful caustic must be resorted to (*see* POST-MORTEM WOUNDS). The best local treatment for condylomata and gonorrhœal warts is the application of some desiccating powder, such as dried alum. It is well to remember that warts which remain a long time uncured are apt to become epitheliomatous; and not only so, but that any chronic irritation, whether from the application of insufficient methods of cure or other causes, is likely to lead to the same result.

6. **Adenomata.** — DEFINITION. — An ill-defined group of tumours, a typical member of which is essentially non-malignant, and is made up of tissue exactly resembling that of the gland from which it springs; but the departures from the ordinary type are so many and so varied, and, at times, so indefinite, that it becomes impossible to draw a clear line between the adenomata and the carcinomata, or indeed between the adenomata and the sarcomata.

(*a*) *Adenoma of the Sweat-glands.*—This class is said to include some non-ulcerating cutaneous tumours (the tubular epitheliomata of some authors); and some ulcerating ones—the cancroids or rodent ulcers have been erroneously placed under this heading. *See* RODENT ULCER.

(*b*) *Adenoma of the Sebaceous Glands.*—This is a rare tumour, growing on different parts of the skin.

Though not strictly a tumour, that local hypertrophy of the skin of the nose, to which the popular name of 'grog-blossom' has been given, must be mentioned here. This forms a nodular purplish tumour, growing from the end of the nose, and often reaching an enormous size. When cut into, it bleeds freely, and exudes from innumerable cavities in its interior an inspissated sebaceous secretion. *Microscopically* it is seen that the connective tissue and the vessels are hypertrophied, as well as the sebaceous glands. The *treatment* consists in removal by the knife; and cicatrisation generally occurs with wonderful rapidity. Recurrence is not uncommon.

(*c*) *Adenoma of the Mucous Glands.*—Under this heading might be included some of the simple polypi of the nose (*see* Fibromata). The best representation, however, is the simple polypus of the rectum. This is a sessile or pedunculated roundish tumour, occurring mostly in children and young subjects. It bleeds freely from the surface, and is often the cause of painful and somewhat troublesome symptoms, amongst which prolapsus ani is the most common. *Microscopically* it consists of tissue closely resembling that of the mucous membrane of the rectum, but the hypertrophied follicles are often embedded in a tissue very similar to that which forms the basis of the mucous polypus of the nose (fig. 10, vol. i. p. 270). The *treatment* is by removal either with the knife or ligature, or some form of snare or écraseur. Recurrence does not, as a rule, take place.

As is stated in the article CANCER, and as is shown in figs. 10 and 11, vol. i. p. 270, it is often almost impossible to distinguish, by their microscopical appearances, the simple adenomata of the large intestine from the malignant growths affecting the same structures. The same observation applies to many tumours of the jaws, such as that in fig. 18, vol. i. p. 270, which, though classed amongst the adenoids, often exhibit a high degree of malignancy.

(*d*) *Adenoma of the Breast.*—The most typical adenoma of the breast is a rounded tumour of moderate size, occurring often at the margin of the gland and frequently near the axillary border, completely encapsuled, and consisting of tissue which hardly differs from ordinary mammary structure (fig. 19, vol. i. p. 270). It occurs usually in young women, often during the child-bearing period. It shows no tendency to recur after removal. A large number of adenoids of the breast do not, however, agree with this description, either as regards position or structure. In structure departure may take place from the normal type in two directions: by an excessive or abnormal development either (1) of the epithelial or (2) of the connective-tissue elements. In the former case the tumour, in proportion to its abnormality, approaches the cancers; in the latter it assumes more and more closely the characters of the sarcomas. Thus we find some of the softer adenomata, as shown in fig. 21, vol. i. p. 270, exhibiting a tendency to recur after removal, in the same way as a carcinoma, and with an almost equal degree of malignancy; while others, presenting characters like those of fig. 22, vol. i. p. 270, may follow the same course as a sarcoma, both as regards the manner of involving surrounding tissues, and the way in which they recur in the viscera. These latter are called *adenosarcomata*, and often attain an enormous size. If the stroma of one of these tumours be in large amount, and fibrous or myxomatous, the names of *fibro-adenoma* and *myxo-adenoma* may be applied. Adenomata often contain cysts, and these cysts not infrequently intracystic growths. They must be treated by removal of the growth.

The reader must be content with the foregoing approximate description of this important class of tumours, the varieties in the nomenclature of which are equal to the number of the authors who have written on the subject. The writer believes that much unnecessary confusion has been caused by this multiplication of names, for a detailed account of which special works must be consulted, as their discussion would lead far beyond the limits of the present article.

(*e*) *Other forms of Adenoma.*—Amongst other rarer forms of adenoma, bearing a more or less close relationship to the glands from which they spring, may be enumerated the following: Adenomata of the testicle or ovary, of the salivary and lacrymal glands, of the liver, and some tumours of the thyroid. Many of the symmetrical enlargements of the thyroid, however, are simply hypertrophies of the gland itself, and should therefore be classed with simple hypertrophy of the breast and ordinary enlarged prostate, rather than with the tumours now under discussion. It should be noted that many of the less typical adenomata, especially those of the salivary glands and the testicle, frequently are found in combination with other heteroplastic growths, such as chondroma, myxoma, or some form of sarcoma.

7. **Lymphoma.**—Under certain circumstances, for an account of which the reader is referred to the article LYMPHADENOMA, the lymphatic glands throughout the body become enlarged, forming tumours, often of enormous size. Occasionally these growths

assume a more malignant character, involving the parts in the neighbourhood of the glands from which they spring, and being followed by the appearance of secondary growths in other parts of the body. To such a condition as this the term *lymphoma* has been applied. The glands are usually soft, but sometimes hard, and in the early stages easily movable amongst, or removable from, the surrounding tissues; in colour they are a yellowish-white, as also are the secondary growths. *Microscopically* they show the structure of an ordinary lymphatic gland, which, it will be observed (fig. 170), differs from that of a small round-celled sarcoma only in the fact that the stroma is much more definite and characteristic. Some of them are perhaps more appropriately called *lympho-sarcoma.*

8. **Myoma.** — Definition.— A tumour composed of muscular tissue.

With certain very rare exceptions, the only form of muscle-tissue occurring as an integral part of a tumour, is the *unstriped* variety; and almost the only position in which this is found is in the so-called 'fibroma' (myoma) of the uterus. This growth consists of a mixture of fibrous tissue with plain muscular fibres in varying amount, usually exhibiting the concentric arrangement of its elements, which was described as characteristic of fibromas generally. Fibromata of the uterus may form pedunculated tumours on the external or internal surface of the uterus, or they may not extend beyond the uterine wall. They give rise to a variety of special symptoms, and require special methods of treatment, which it is beyond the scope of this article to discuss. *See* Womb, Diseases of.

Striped muscular fibre has been found in a few cases of congenital tumour of the kidneys; and the writer has also seen it in a fatty tumour growing inside the spinal canal.

9. **Neuromata.**—Definition.—Tumours composed essentially of any form of nerve-tissue.

The majority of neuromas are really fibromas, that is, fibrous tumours developed amongst and around the fibres of the nerve from which they spring. The idiopathic forms are sometimes single, but generally multiple, of small size, very hard, and affecting usually the branches of a particular cutaneous nerve. The amount of pain and tenderness caused by these growths varies very much, but is sometimes excessive. A clinical feature of some use in diagnosis is the fact that they usually move readily in the lateral, but very imperfectly in the vertical direction. What may be called traumatic neuromata, are fibromas containing tortuous outgrowths of the nerve-fibres developed at the end of a divided nerve in a stump. These often cause excessive pain, and peculiar reflex phenomena; while they show a remarkable tendency to recur after removal. Neuromata on the cranial nerves are rare; they may cause serious and characteristic symptoms. Still rarer are the true neuromata of the brain and spinal column, and those occasionally met with in connexion with the nerves or ganglia of the sympathetic.

It must not be forgotten that less simple tumours not infrequently affect nerves, such as the various forms of sarcoma, or myxoma. No special description of these growths in this situation is, however, required.

10. **Angioma.**—Synon.: Teleangiectasis.

Definition.—A tumour composed of blood-vessels.

Angiomata divide themselves naturally into those in which the *capillary* element predominates; and those which are chiefly made up of vessels of *larger* size.

(*a*) *Capillary angiomata.*—Description.— These are the *nævi*, which, while they sometimes form tumours of some magnitude, often, as in the case of so-called 'claret-cheek,' involve no increase in the size of the affected part. Nævi are nearly always congenital, hence the term 'mother's mark.' They may be subdivided into *cutaneous* and *subcutaneous* nævi. The former are of a more or less bright red colour, and affect only the cutaneous structures or mucous membrane; the latter, as seen through the skin, in cases where this remains unaffected, have a purplish tint, and may involve any of the deeper structures of the body. They are usually as circumscribed as fatty tumours, and very commonly involve the skin. Nævi often grow with extreme rapidity, and though they involve no danger to life (except in such rare conditions as when serious or fatal hæmorrhage occurs from a nævus of the pelvis of the kidney or of the rectum), they may cause serious inconvenience and great disfigurement. Sometimes, however, they exhibit a tendency to spontaneous disappearance, and often they remain permanently stationary. They are liable to various forms of degeneration, notably the cystic, and the ulcerative or suppurative.

Microscopically a nævus is composed of large capillaries, amongst which are seen arterial and venous trunks of larger size. Between the vessels is found connective tissue or fat, and sometimes the special constituents of the skin, such as sweat or sebaceous glands. The nævus-element enters rather largely into the composition of some other tumours, and notably of congenital moles (*benignant melanoses*).

Treatment. — Inflammation of a nævus generally leads to spontaneous cure; nature thus suggesting one of the best methods of treatment at the disposal of the surgeon, namely, the injection of the tumour with some suitable irritant, such as carbolic acid. In adopting this line of treatment, it must be remembered that a danger exists of the irritating fluid entering a larger vessel, and by passing to the heart and setting up coagulation there causing instant death; this may be guarded against by the application of a temporary ligature. Other recognised and useful plans of treatment are the following: the ligature, pressure, the application of caustics—and especially fuming nitric acid, electrolysis, puncture with the actual cautery, and complete excision of the mass. The last in available situations affords the most speedy cure, and often leaves the least conspicuous scar.

(*b*) *Cavernous angiomata.*—Description. Those angiomata which are made up of larger vessels, and which are hence called the cavernous angiomata, from their resemblance in structure to erectile tissue, consist of cavernous spaces, communicating by smaller or larger vessels, and separated by trabeculæ of greater or less thickness and substance. These are the *pulsating nævi*, and perhaps some of the so-called *aneurysms by anastomosis.* They are of a more dusky colour than simple nævi, and often present a distinct thrill or bruit, which is perceptible both to the patient and to the surgeon. They are sometimes encapsuled, sometimes diffused; and in the latter case show an almost malignant tendency to involve neighbouring structures. The pulsation is often a most distressing symptom to the patient, if the tumour be found occupying such positions as the pinna of the ear or the fat of the orbit, both of which situations are not at all uncommon for the occurrence of the disease. *Microscopically* a cavernous angioma presents fibrous trabeculæ, lined with the characteristic vascular endothelium, and in parts perhaps separated by layers of areolar or any other tissue which the tumour may happen to involve.

Treatment.—The treatment must be pursued on the same lines as that for the simple forms of nævus. But injection is a much more dangerous proceeding on account of the large size of the vessels, and excision is apt to be accompanied with serious hæmorrhage, because of the enlargement of the vessels in the neighbourhood.

11. **Lymphangioma.**—Definition.—A rare kind of tumour, which may briefly be described as a cavernous angioma made up of lymphatic vessels.

To this class belong some curious and uncommon flat pinkish elevations of the skin, characterised by the presence of minute vessels containing clear fluid, and particularly prone to erysipelatous inflammation. It also in all probability includes the *cystic hygromas* occasionally met with congenitally, forming large masses in the neck, beneath the tongue, on the upper extremities, or, rarely, in other parts of the body, and perhaps also some forms of elephantiasis Arabum. Our knowledge of the pathology and treatment of these tumours is at present very imperfect, and the literature on the subject is extremely meagre. The reader is referred, for an account of all forms of angiomata, to the fourth volume of Virchow's *Die krankhaften Geschwülste.*

B. **Sarcomata.**—Definition.—It is to be regretted that the term 'sarcoma' has not been allowed to slip out of pathological terminology. From the days of Galen almost to our own time it has served, in the hands of different authors, to designate different classes of tumours, sometimes of the simplest, sometimes of the most malignant character. Virchow, however, has given a meaning to the word which is now generally recognised by pathologists. He includes under *sarcomas* those new-growths which, while they do not actually consist of any of the tissues of the adult body, are evidently built on the connective-tissue type, and consist of a modification of the connective tissue of the embryo. They are thus very closely related to some of the simple tumours, and indeed often include portions of some normal tissue, such as bone, cartilage, or fibrous tissue—a fact which necessitates the employment of complicated and confusing names, including *osteo-sarcoma*, *chondrosarcoma*, *fibro-sarcoma*, and such-like.

Microscopical Characters.—Histologically, then, a sarcoma is made up simply of cells of the connective-tissue type, which may assume very various shapes and sizes in different tumours, and which are surrounded by a varying amount of intercellular substance.

Clinical Characters.—Theoretically sarcomata should always be developed in one of the connective-tissue structures, and practically they are not very often seen to originate in a secreting gland. But a glandular origin is not by any means very uncommon, as indeed might have been expected when it is remembered that every gland contains a considerable amount of connective tissue. Sarcomas present all degrees of malignancy; but, as a rough rule, it may be stated that the higher the degree of development of the tumour, the less likely is recurrence to take place after removal. In connexion with this point it is interesting to note that each recurrence of a sarcoma often shows a more rudimentary structure, but at the same time a greater degree of malignancy.

Recurrence does not follow the same rule that has been observed in the case of cancer. The lymphatic glands often escape altogether, or are but slightly affected; while fresh tumours spring up in abundance in distant parts of the body.

Sarcomas increase in size in the same way as cancers, but in the less malignant forms are often surrounded by a more or less distinct capsule.

Naked-Eye Appearances.—The naked-eye appearances of sarcomata are subject to very wide variations. It may, however, be observed that they never present the hollowed surface on section which is characteristic of some cancers; and they do not, except in the case of the softest tumours, exude a milky juice on scraping. Sarcomata are well supplied with vessels.

VARIETIES.—1. *Round-celled Sarcomata.* These are the most rudimentary, and, as a rule, the most malignant of this class. They are usually soft—sometimes very soft, seldom encapsuled, and generally of a whitish colour. Formerly they were classed amongst the medullary cancers. They are made up of round cells, as the name implies, and have a tendency to group themselves into two classes, in one of which the cells are *small* and uniform in size (fig. 168), closely resembling those of granulation-tissue; and in the other large, sometimes very large, and often somewhat irregular (fig. 167). The intercellular substance may be copious and homogeneous, in which case the tumour approaches the myxomata; or smaller in amount and fibrous, when, if the cells are small, it may be difficult to separate such a sarcoma from the lymphomata. To some of these the term *lymphosarcoma* has been applied. Such tumours occur in the tonsil, or may start in the lymphatic glands.

Under this head must be placed the *Gliomata*—soft medullary tumours met with in the brain or in connexion with nerves, frequently with the retina, and occurring commonly in children. They show microscopically a delicate stroma.

2. *Oval-celled Sarcomata.*—This variety of sarcoma represents the next stage in advance from the simplest towards a more complex structure. They differ, in fact, but slightly from the round-celled growth, either in clinical or in microscopical characters (fig. 169), but may be looked upon as intermediate between these and the spindle-celled sarcomas.

3. *Spindle-celled Sarcomata.*—This class must be subdivided into the *small spindle-celled*, and the *large spindle-celled* varieties.

The *small spindle-celled sarcomata* are firm, whitish, well-defined tumours, which approach the fibromata, sometimes very closely, and which after complete removal show a comparatively slight tendency to recur. These were the *recurrent fibroids* of older writers. *Microscopically* (fig. 171) they consist of broad interlacing bands of elongated cells, with but little intercellular material—a structure which does not differ widely from imperfectly formed fibrous tissue.

The *large spindle-celled sarcomata* (fig. 175) are softer growths, frequently supplied with a very imperfect capsule, generally pinkish on section, or stained in parts dark red from extravasated blood, and often showing cysts. They may occur in any fibrous structure, but are rather common in connexion with the periosteum. The malignancy of these growths is much greater than that of the small-celled class. *Microscopically* they consist of very large nucleated cells, with long tapering tails, and but little intercellular substance. These are the *fibro-plastic* tumours.

4. *Alveolar Sarcomata.*—Examined *microscopically* this rare form of tumour (fig. 172) bears a superficial resemblance to a cancer. There is, that is to say, a coarse stroma forming alveolar spaces, each of which contains a variable number of large, round, nucleated cells; each space is, however, again subdivided by a very delicate secondary intercellular stroma. This is only demonstrable on pencilling out the cells, which, unlike a similar process applied to a cancer, is a work of considerable difficulty. Alveolar sarcomas affect most commonly subcutaneous tissues primarily; they are apt to recur in other parts of the body, and ultimately in internal organs, but often run a very chronic course.

5. *Mixed Sarcomata.*—Tumours are often met with which present a mixture of the different structures just described. Such are conveniently called mixed sarcomata; and the term may with advantage be made to include those growths which contain, besides sarcoma-tissue, bone, cartilage, gland-tissue, and what not. The latter growths will necessitate the employment of such names as osteo-sarcoma, chondro-sarcoma, adeno-sarcoma, &c.

6. **Myeloid.**—SYNON.: Giant-celled Sarcomata.—These tumours are best classed amongst the sarcomata. *Microscopically* (fig. 166) they present the following elements, one or other of which may greatly predominate: fibro-plastic or spindle-cells, oval or round cells, and very large nucleated cells, the so-called 'myeloid' or 'giant' cells. These last are irregular or rounded collections of granular protoplasm, in which occur numerous clear oval nuclei, containing a well-marked nucleolus. The amount of intercellular substance is small. In a fresh scraping, the clear oval nuclei are set free by the breaking up of the giant-cells. To the naked eye a section of a myeloid tumour is pink or yellowish, but almost always mottled with darker spots, the result of extravasations of blood. Very frequently, tumours of this class present points of ossification or calcification, and not infrequently cysts. They are very soft, and usually yield a thick juice on scraping. They generally originate in, or, more rarely, close to, the end of one of the long bones; probably most often in the medullary cavity or the cancellous structure. Another frequent seat is the alveolar border of the jaws, where they form the myeloid epulis. They occur most often in young people, and if the bone involved be removed completely or in great part, have no tendency to recur; but, on the other hand, they

may exhibit a high degree of malignancy, recurring not only in other bones, but in internal organs. It is said that myeloid epulides may in time become completely fibrous.

7. **Myxoma.** — It is not easy to say whether myxomata should be classed amongst the sarcomata or amongst the simple tumours. On the one hand, the tissue of which a myxoma is composed finds no representative in the adult, unless that of the vitreous body be taken as such; but, on the other, they approach very closely some of the soft fibromata, and are nearly related to fatty tumours. At the same time a large number of myxomas appear to be actual chondromata.

Microscopically (fig. 162) a myxoma presents elongated or roundish much-branched cells, the prolongations of which intercommunicate freely. These cells are embedded in a copious, homogeneous, transparent matrix. The structure thus resembles that of fœtal fat; but, in myxomata developed from cartilage, each cell is contained in a space similar to that enclosing a cartilage cell.

Clinically these tumours are very soft and elastic, strictly encapsuled, gelatinous, semitransparent on section, and exuding a peculiar mucous juice. Myxomata are not malignant; and as a rule, if completely removed, do not recur locally. They may be found in many parts of the body, but perhaps most frequently in the subcutaneous tissue, or in connexion with some gland, particularly the parotid. Here, however, they are often mixed with adenoid and cartilaginous material. Not infrequently myxoma-tissue is combined with that of an undoubted sarcoma, which necessitates the term *myxo-sarcoma*. These tumours may occasionally be mistaken for colloid cancers. Histologically some of the soft enchondromata resemble them very closely.

8 and 9. **Osteo-Sarcoma**; and **Chondro-Sarcoma.**—These forms of sarcoma have just been referred to under the head of *Mixed Sarcoma*.

10. **Melanotic Sarcomata.** — These tumours are, in the experience of the writer, usually of the mixed, round, and spindle-celled variety. Some, but not all, of the cells contain a brown pigment, but in very varying amount, and pigment is also found outside the cells (fig. 174). This gives the tumour a brown or blackish appearance. These tumours, though often completely encapsuled, show a high degree of malignancy; but are often succeeded by a mixture of white and black tumours, or sometimes by white tumours alone. They are not uncommon in connexion with the choroid of the eye, and as affecting the papillæ of the skin (malignant mole), but have often been met with primarily in other parts of the body. The secondary growths are often found disseminated through every tissue of the body, forming tumours in such situations as the intestine, of peculiar and characteristic appearance. Secondary deposits in lymphatic glands are more common than is the case in other forms of sarcoma. It has been observed that in some cases of melanosis black pigment, accompanied with other morbid appearances, has been found in the blood, and also in the urine.

11. **Fatty Sarcomata.**—These are rare tumours in which some of the cells are distended with globules of fat.

12. **Psammoma.**—It is only necessary to mention this very rare tumour, which is found only in connexion with the membranes of the brain. It is composed of flattened cells, and is characterised by the peculiarity of containing brain-sand in its interior. It seldom or never gives rise to symptoms.

Teratoma. — Mention must be made, in conclusion, of a form of growth, which does not come within the classification here selected. This is a congenital tumour not infrequently met with in the region of the sacrum (*congenital sacral tumour*), but occasionally seen elsewhere; often reaching a size almost equal to that of the infant itself. In structure these tumours consist of various imperfectly developed fœtal or mature elements of the body, mixed together in apparently great confusion. Various theories as to their causation have been propounded; such, for example, as that they consist of an imperfect attached fœtus, or that they originate from Luschka's gland; but we have not sufficient data at present to express an opinion on this point. Attempts at their cure by removal are attended with great danger.

R. J. Godlee.

TUNBRIDGE WELLS, in Kent.—Iron waters. *See* Mineral Waters.

TUNNEL-WORM.—A synonym for the Ankylostoma duodenale. *See* Entozoa.

TURGESCENCE (*turgesco*, I swell).—A term applied to a swollen condition of a part, generally associated with fulness of the blood-vessels, as in the mucous membrane of the conjunctiva, the fauces, or the rectum. *See* Swelling.

TUSSIS (Lat.).—A synonym for cough. *See* Cough.

TUSSIVE.—This word is applied to certain physical signs which are elicited by the act of coughing, such as *tussive fremitus* and *tussive resonance*. *See* Physical Examination.

TYLOSIS (τυλόω, I make hard or callous). Synon.: Callosity.

Definition.—Thickenings of the epithelium, occurring on parts of the body that are habitually subjected to pressure or friction. Tylosis is found, for example, on the feet, from the wearing of shoes; on the hands, from rowing or the constant use of some implement or tool; and on other parts of the body unduly submitted to pressure. A corn begins by being a callus, and only rightfully acquires the title of corn when it has forced itself at a given point against the derma, and has depressed the latter to a greater or less extent, thereby producing pain and suffering. Callosities are inconvenient rather than painful; but occasionally treatment is necessary. *Tylosis linguæ* is described under TONGUE, Diseases of: 8. Leucoma.

TREATMENT.—The best remedy under the above circumstances is the removal or avoidance of the cause. Next to this, the hardened cuticle may be softened by soaking in hot water, or by means of a water-dressing, and afterwards scraped. Or it may be painted over with a solution of salicylic acid in flexible collodion, until the excess of cuticle exfoliates in laminæ and flakes. In either case, the skin must be subsequently protected, in order to prevent it from retrograding into its former state. ERASMUS WILSON.

TYMPANITES (*tympanum*, a drum). SYNON.: Fr. *Tympanite*; Ger. *Windsucht.*—This word is associated with the distension of the abdomen that results from excessive accumulation of gas within its cavity. As a rule, the gas collects in the interior of the alimentary canal, especially the intestines; but in exceptional cases it occupies the peritoneal cavity.

ÆTIOLOGY.—Tympanites is chiefly met with under the following circumstances: 1. In connexion with certain diseases which, from their local effects, tend to paralyse the intestines, especially acute peritonitis, typhoid fever, and dysentery. 2. In cases of intestinal obstruction from any cause, but particularly when this condition is acute, and situated low down. 3. In certain low febrile diseases, accompanied with the 'typhoid state,' and tending towards a fatal issue, such as typhus fever, small-pox, erysipelas, and typhoid pneumonia. 4. As a result of perforation of the stomach or intestine. 5. In certain cases of chronic disease of the spinal cord. 6. In connexion with hysteria sometimes. In all these conditions, except where the gas escapes into the peritoneal cavity, the immediate cause of the tympanites is a more or less paralysed state of the walls of the intestines; but there is often, at the same time, an excessive formation of gas in their interior.

SYMPTOMS.—The symptoms of tympanites are due to the mechanical effects of the gaseous accumulation. The patient is usually conscious of the distension of the abdomen, and the sensation may amount to extreme discomfort or actual suffering and great distress, there being a feeling in some instances as if the abdomen must burst if the condition is not relieved. The mental state of the patient may, however, be such that he is unconscious of, or indifferent to, any unusual sensations. Breathing is often interfered with in various degrees, and the act may be very hurried, with a feeling of urgent dyspnœa. The heart is also liable to be affected, and its action more or less disturbed. The secretion of urine may be interfered with, even almost to actual suppression.

PHYSICAL SIGNS.—These are usually very characteristic. 1. The abdomen is uniformly enlarged, often to an extreme degree; being of a rounded shape; equal and symmetrical in every part, unless there happen to be a portion of bowel specially distended, and without any tendency to undue prominence in dependent parts. The skin is stretched more or less, but there is no protrusion of the umbilicus. 2. The sensations on palpation are those of perfect smoothness and regularity, with great tension or a drum-like feel. 3. Percussion gives a general tympanitic sound over the abdomen, and also brings out the drum-like sensation. If, however, the distension is extreme, the sound becomes more or less muffled and toneless. Generally the dulness of the solid organs in the abdomen is partially or entirely obscured, or is displaced upwards. 4. Change of posture produces no alteration in the physical signs. 5. There may be indications of displacement of the thoracic organs. It must be mentioned that tympanites may be associated with some fluid in the peritoneal cavity, or with other conditions, and the physical signs will be modified accordingly.

TREATMENT.—In the first instance, any obvious and immediate cause of tympanites must be removed, if practicable, such as intestinal obstruction, or an accumulation of fæces. If the symptom calls for direct treatment, relief may be afforded in some cases by applying heat, sinapisms, or turpentine stupes over the abdomen; and administering internally such remedies as brandy, aromatic spirit of ammonia, the various ethers, the volatile oils, camphor, musk, valerian, sumbul, galbanum, asafœtida, or other gum-resins. Should these fail, enemata containing asafœtida or turpentine may not uncommonly be used with advantage. The passage of a long tube through the anus into the bowel, reaching as high up as possible, such as an œsophagus-tube, is often very serviceable. In extreme cases it is allowable to puncture the large bowel in several points by means of a very small trocar, and thus afford an exit for the contained gas. This operation, however, must not be practised if there is any danger of fæcal matters gaining access into the peritoneal cavity through the punctures. When gas accumulates in this cavity, it can only be got rid of by surgical interference, should such interference be otherwise indicated.

FREDERICK T. ROBERTS.

TYMPANITIC (*tympanum*, a drum). A peculiar drum-like quality of sound elicited by percussion (*see* PHYSICAL EXAMINATION). The term is also applied to the abdomen, when it is distended with gas. *See* TYMPANITES.

TYMPANUM, Diseases of.—*See* EAR, Diseases of.

TYPES OF DISEASE.—*See* DISEASE, Types and Varieties of.

TYPHLITIS (τυφλόν, the cæcum).—Inflammation of the cæcum. *See* CÆCUM, Diseases of; and PERITYPHLITIS.

TYPHOID FEVER (τῦφος, stupor).—SYNON.: Enteric Fever; Pythogenic Fever; Gastric Fever; Infantile Remittent Fever; Fr. *Fièvre Typhoïde*; *Fièvre Gastrique*; *Dothiénentérie*; Ger. *Typhus Abdominalis.*

DEFINITION.—A continued fever of long duration; usually attended with diarrhœa; and characterised by peculiar intestinal lesions, an eruption of small rose spots, and enlargement of the spleen.

ÆTIOLOGY.—In common with other continued fevers, typhoid fever is due to the introduction from without of a specific poison into a system more or less predisposed to the disease. The nature and origin of the poison, and the modes in which it is propagated, are questions of extreme interest and importance, and they will be the first to be considered.

With regard to the origin of the poison two distinct views have been entertained: one that it is specific in its nature, and derived only from some pre-existing case of the disease; the other that, while usually produced in and derived from a person suffering from fever, it may also be generated anew by the decomposition of sewage, and perhaps of other forms of animal filth. The former of these views is associated with the name of the late Dr. Budd of Bristol; the latter, or pythogenic, hypothesis had its chief supporter in the late Dr. Murchison. Fortunately, the practical issue of both theories is the same, namely, that the great preventive measure is the prompt removal of fæcal matters, so that neither air nor water may be contaminated by them.

Typhoid fever is now generally supposed to be due to a specific *typhoid bacillus*; but for details on this subject the reader is referred to the article MICRO-ORGANISMS.

It is accepted on all hands that the typhoid poison is reproduced in the system during the fever, and that its chief, if not exclusive, outlet is in the intestinal discharges. There is no evidence that it is conveyed at all by the breath or perspiration, or by the urinary secretion. While, however, the contagium is present in the fæces, it has not apparently at the moment of their passage its full virulence, but requires for its complete development a certain period of time, and this is forwarded by some conditions, retarded or prevented by others. Exposure to sunlight and open air, as in flowing rivers, is inimical to the development of the typhoid microbe, and probably indeed destroys it. On the other hand, warmth, stagnation, seclusion from open air, accumulation and concentration of the infected discharges intensify the poison, and it would seem that a small amount of typhoid evacuations may give rise to a large development of the contagium in excretory matters with which they become mingled, and even in milk to which they may obtain access. This increase by a sort of fermentation explains the autumnal prevalence of typhoid fever observed in large towns, and the association pointed out by Dr. Murchison between a hot and dry summer and a high fever-rate in London; the drains not being flushed by abundant rainfall, sewage accumulates and stagnates in them, and typhoid stools never being wanting, the specific fermentation goes on rapidly under the influence of the high temperature, and produces the poison in quantity and intensity. It is possible, however, to put another interpretation on facts of this kind, and to attribute the generation of contagium to fermentation of fæcal matters, independently of any specific germ introduced in typhoid evacuations. Such is, indeed, the basis of the pythogenic theory of origin of typhoid fever. It is impossible to reproduce here the discussion of the question as to the specific or non-specific character and source of the contagium. There is overwhelming evidence that, as a rule, the poison is derived from some previous case; and the only facts which seem to require the supposition of its independent origin are occasional outbreaks of fever in villages or isolated buildings which cannot be traced to any known source. On similar grounds, however, we should have to admit the origin *de novo* of small-pox and all other contagious affections, and it should be added that, with increasing experience in investigations of this kind, unexplained outbreaks become more and more rare. There are again many instances known in which water largely contaminated by sewage has been consumed for years without giving rise to fever, until the sewage has itself been contaminated by typhoid excreta, when an epidemic has at once broken out. So with regard to milk, impure water has been habitually employed in its adulteration without traceable bad effects; but when to this water typhoid poison has gained access, the disease has immediately begun to be distributed with the milk.

The modes in which typhoid fever is disseminated are various. It is rarely, if ever, transmitted directly from person to person. Medical men, clergymen, and others visiting those who are suffering are not attacked, nurses very rarely, when proper precautions are observed. If, however, bedclothes or carpets soiled by the evacuations are not removed, and still more where gross neglect of cleanliness and decency is permitted, attendants will contract the disease.

The most common vehicle of the poison is drinking-water, which may be contaminated in various ways, mostly through sewage. The water-supply of a town may be thus poisoned at its source, such as a river into which drains empty themselves, or a reservoir or well accidentally contaminated; or the pipes of distribution, when the supply is intermittent, may while empty become charged with sewer gases, or may even receive sewage; or excessive rainfall may, in villages and small towns, wash the contents of cesspools into wells. This same rainfall, by flushing the sewers of well-drained towns, and washing away the specific poison, has often a contrary effect in towns and country. In some places the subsoil water, permeating a bed of gravel, is at the same time the well-water of a village and a reservoir of its sewage. An imported case of fever will under these conditions poison almost the entire community. With these examples of wholesale dissemination of typhoid fever must be mentioned the so-called 'milk epidemics' already alluded to. A case of fever occurs at a farm, or among the employés of a dairy; from defective sanitary arrangements the water used at the farm or dairy becomes contaminated by the excreta; this is added to the milk as an adulteration, or, as is usually said, is used in washing out the cans, and in this way the poison obtains access to the milk, where apparently it must increase very rapidly. Hundreds of cases have been traced to a single dairy.

More commonly, perhaps, the occurrence of typhoid fever is traceable to the absence of proper sanitary arrangements in individual houses. Not to speak of cesspools and leaking drain-pipes allowing the basement to be sodden with sewage, sinks or water-closets may be imperfectly trapped, and sewer-gas diffuses through the apartments or is drawn into the living-rooms by fires, or is forced into the house by pressure in the main drains, when the poison probably enters the system through the lungs. Or the waste-pipe of the cistern is in direct communication with the drains, and sewer-gases conveyed by it are confined in the space under the cistern-lid, and absorbed by the water used for drinking purposes, which conveys the poison. In connexion with these modes of dissemination it should be borne in mind that well-made and close-fitting doors and windows may aid in compelling foul air to enter from the drains or subsoil, and that houses in elevated situations, and thus apparently well placed for drainage, are in greater danger from pressure of gases in the main drains.

It is again possible that emanations from a newly opened drain, or cesspool, or foul privy, may communicate the disease by atmospheric contagion—though this is comparatively rare—it being understood always that typhoid excreta form part of the contents. But a drain open to the air throughout its course, however offensive, is not so likely to give the disease as closed and unventilated sewers; and sewage-farms, if at all well managed, are quite harmless.

It should be added that while, in this country and in Europe generally, all the evidence tends increasingly to confirm the dependence of typhoid fever on pre-existing cases, and the dissemination by drinking-water as its chief mode of propagation, observations and investigations in India appeared till recently to show either that typhoid fever can there arise independently, or at least differently, or that there is a disease not yet distinguished from typhoid fever which has a different method of rise and spread. Dr. Climo, however, has in a series of admirable papers brought forward convincing evidence that the part played by water here is in India played by dust, which conveys the poison in the dry state to articles of food and drink.

It is unnecessary here to discuss Pettenkofer's hypothesis that the varying prevalence of typhoid fever is connected with the varying level of the subsoil water, which as it rises displaces gases which have become saturated with poison from the soil into the atmosphere. It certainly does not apply to the facts as observed in this country.

One word must be said with regard to individual susceptibility to the disease, and with regard to predisposing causes acting on the individual. It is a matter of almost daily observation that some persons never contract typhoid fever, however much they may be exposed to the poison, while others take it readily; and it is almost equally obvious that certain families are extremely susceptible, and liable to have the disease in a severe form. It is always a reason to apprehend a formidable attack if a parent have died of the fever. Typhoid fever may occur at any age, but it is very rare in advanced life. It is probably more common in infancy than is generally supposed, as it is easily overlooked or confounded with common infantile ailments. The period of life at which the disease is most common is during adolescence and the first decade of adult age. Among the predisposing causes are mental depression or shock, over-work, and debility, however induced. A person habitually imbibing the poison may not be attacked until his power of resistance is impaired by some depressing influence. In this way a chill may appear to bring on the disease. It is natural to suppose that unfavourable hygienic conditions would generate a predisposition, but doubt is thrown on this by the fact that typhoid fever does not by any means predominantly affect the poor. The influence of habitual consumption of impure water, again, is not very clear. In some instances it has appeared to make an epidemic severe, but, on the other hand, it would almost seem that the inhabitants of some towns, the water of which is constantly contaminated, acquire an immunity from the disease.

Anatomical Characters and Pathology. Special interest attaches to the structural lesions which take place in typhoid fever, as they are closely associated with the symptoms, and are accountable for many of the complications which occur. The relation of the intestinal lesions to the febrile process has been differently interpreted. They have been considered, on the one hand, as the focus in which the morbid germs multiply, and from which the blood is infected; and, on the other, the primary change has been supposed to take place in the blood, the lesions being secondary to this, like the pustules in small-pox. In fatal cases local congestions and inflammations are met with in the lungs and other organs, but the special and characteristic lesions are those taking place in the intestines and mesenteric glands. The intestinal mucous membrane of the ileum generally presents the appearances of acute catarrh; but the chief seat of the morbid changes is Peyer's patches, and the changes consist in a gradual infiltration of the glands here crowded together, followed by ulceration. The process is divisible into three stages — of *infiltration*, *ulceration*, and *separation* or *resolution*, each of which may be said, speaking roughly, to occupy a week. In the first, that of infiltration, the glands of Peyer's patches are swollen and distended by a corpuscular exudation. The entire patch is thickened and raised above the level of the surrounding mucous membrane; has a reddish, or fawn, or grey colour, according to the intensity and stage of the inflammation, and an irregular surface; is firm to the touch; and opaque when the intestine is held up to the light, often showing through the peritoneal covering.

The patches are attacked successively from below upwards; and as they are largest and most numerous at the lower end of the ileum near the ileo-cæcal valve, it is here that the lesions are most extensive and most advanced.

In about a week the follicles begin to ulcerate, or, as it is sometimes said, burst. This marks the beginning of the second stage; as it progresses, the minute ulcerations extend and coalesce, the patch having first a worm-eaten appearance, and later becoming one large ulcer, which may be superficial or deep; in very severe cases the patches slough and fall off as a whole, a deep line of demarcation forming round them. At this period they are stained with bile, or when gangrenous are almost black.

During the third week in mild cases a sort of resolution may occur, the infiltrated material being broken down and absorbed; and this change probably takes place in patches high up in the ileum when in those lower down there is ulcerative destruction. For the most part this stage is occupied by the separation by ulceration or sloughing of the affected patches, and an ulcer is left of corresponding size and shape. Of course, as the patches run longitudinally along the aspect of the bowel, away from the mesenteric attachment, the ulcers also have their long diameter in the same direction. The superficial layer only of the mucous membrane may be ulcerated, or its entire thickness may be destroyed, and where there has been necrosis of a patch as a whole, the muscular coat may be implicated, and even in some cases the peritoneal covering. When the muscular fibres are laid bare, and especially when they are partially destroyed, the base of the ulcer will have a shreddy appearance. Large vessels may be opened, giving rise to hæmorrhage; or perforation of the intestine may take place from necrosis of the serous coat, near the centre of the ulcer, and a perforation formed in this way will usually be large.

At the end of the third week the separation of the diseased patches will be completed, and the ulcerations left begin to granulate. There is for some time a liability to hæmorrhage from erosion of vessels, and perforation may still occur, the apertures now, however, being as a rule minute. Unless perforation has been preceded by adhesion to some neighbouring coil of intestine, which may possibly be the case at this period, the escape of gas and extravasation of liquid fæcal matter will set up general peritonitis, which is almost always fatal. The time required for complete healing of the ulcers varies.

Besides the large ulcers formed in the patches of Peyer, it is not uncommon to find small circular ulcerations scattered over the mucous membrane, and at times minute disseminated ulcers constitute the predominant lesion, Peyer's patches being absent, or, if present, little affected. The large intestine is usually healthy or nearly so, the ileo-cæcal valve forming a sharp demarcation between healthy and diseased mucous membrane, but in some cases there are numerous small ulcerations in the cæcum and colon.

The changes in the mesenteric glands are secondary to those in the intestinal mucous membrane. The glands are enlarged, firm, pink or fawn-coloured, and present on section a corpuscular infiltration like that affecting the agminated glands. Later, they become paler and softer, and may gradually return to a normal condition, or may undergo caseation. Ulcerations, superficial or deep, are not uncommonly present in the larynx.

The spleen is almost always much enlarged, dark in colour, and soft.

Granular degeneration of the gland-cells of the liver and kidneys, of the muscular fibres of the heart, and of the voluntary muscles generally, is a constant morbid change. It is due to the prolonged high fever, and proportionate to its severity and duration; when it reaches an advanced stage, it may be the cause of fatal syncope from failure of the heart.

Symptoms.—The period of *incubation* of typhoid fever is not definitely known. There is great difficulty in fixing it, as the date of exposure to the poison can rarely be exactly ascertained, and the onset of the attack is usually insidious. It is certain, however, that the incubation-period is long, probably in most cases from fourteen to twenty-one days. Cases are met with from time to time which suggest that the poison may reside in the system for an indefinite period until the resistance is lowered by a chill, or an attack of influenza, or by great fatigue. On the other hand instances are on record in which the disease appears to have come on immediately after exposure to powerful emanations from sewers which have burst, or have been opened on account of obstruction, but they are quite exceptional. The incubation is not attended by any marked symptoms; sometimes the appetite falls off, the tongue becomes furred, and there is headache or depression; but, as a rule, the patient is not debarred from his avocation, and there may be no complaint of any kind.

Invasion.—The invasion is almost always insidious. Occasionally severe headache sets in suddenly, with depression, muscular weakness, general pains, and chilliness almost amounting to rigor; but, as a rule, the patient at first feels simply out of sorts, loses appetite, and is indisposed for his usual work or for exertion of any kind. Epistaxis is not uncommon. The headache increases; the prostration becomes greater; sensations of cold down the back, alternating with heat and slight flushing, come on at intervals. At this point medical advice is usually sought, when the patient, giving the above history, will be found to present the ordinary indications of the febrile state—the pulse will be increased in frequency, the temperature raised, and the tongue will have a whitish or yellow coat, thick or thin in different cases. The bowels may be confined or relaxed; the urine high-coloured and diminished in quantity, or so far apparently normal.

In endeavouring at this early period to decide whether the case is one of enteric fever, the first thing to be done is to exclude local inflammation as a cause of the pyrexia. Among the positive indications the appearance of the patient is often a guide; he may look more heavy and oppressed than is accounted for by the temperature or the duration of the illness, and may be more prostrate. The tongue, as a rule, is not thickly coated, and the fur does not extend quite to the margins or tip, which even now may be unduly red. The abdomen may be tumid, and there may be some tenderness over the right iliac fossa, but the absence of these symptoms does not exclude enteric fever. The recurrence two or three times of slight epistaxis during the first few days of a febrile attack would increase the presumption of the disease being typhoid. The temperature, however, if it is watched from the first, affords the most conclusive early evidence of the disease; it rises with remarkable regularity from day to day, and is from one to two degrees higher in the evening than in the morning; the appearance of the temperature-chart recording morning and evening observations is highly characteristic, and may, indeed, almost be called diagnostic. The opportunity of watching this gradual rise, however, is often wanting; but if, on the third or fourth day of an illness, without obvious local cause we find a temperature of 103° or 104° F., and especially if the evening rise and morning fall are marked, the probabilities are that the case is one of enteric fever.

As has been stated, the fever is of long duration, lasting from twenty-one to thirty days on an average, and probably the clearest idea of the course and progress of the disease will be conveyed by a brief description of the condition of the patient week by week, during a fairly severe attack.

At the end of the first week the temperature will have reached the level, whatever that may be, which will be maintained, in the absence of complications, throughout the dominant stage of the disease—103°, 104°, or 105° F. in the evening, 1° or 1½° F. lower in the morning; in mild cases it may not be more than 102° F. when highest. The fever is now well-established, and all its characteristic features will be more or less pronounced. The initial headache will in most cases have disappeared; the patient lies on the back or on either side; the face is flushed, often presenting a bright patch on the cheeks, rarely dusky; the expression is good, though usually suggestive of the disease; the eyes are bright and observant; the skin is more or less hot, usually dry, but often moist at some period of the day. The pulse is frequent, 80, 100, or 120—short, large, and very often dicrotous. A short cough is common; and a scattered sibilus, heard on auscultating the lungs, is so frequent as to constitute a feature of the disease. The tongue will be moist, with a white or yellowish fur thinning off towards the edges and tip; the margins are red, and a red triangle invades the dorsum at the tip. The abdomen will be more or less tumid; and on pressure tenderness may be elicited in the right iliac fossa, and gurgling of liquid and gas may be felt in the intestine. It is to be understood that the gurgling is an incident attendant on diarrhœa, and is absent in cases where there is constipation. The spleen may sometimes be felt below the ribs, and when not reached from the left hypochondrium may give an enlarged area of dulness on percussion, but it will not yet have reached its full size. The characteristic spots may occasionally be found, but though they have been seen as early as the fourth or fifth day, they do not usually come out till after a week or more of fever. The bowels will mostly act loosely, and sometimes frequently, so that there is diarrhœa. The urine will be high-coloured and generally turbid; it not infrequently shows a trace of albumin and may contain an appreciable amount. The motions will have a powerful and offensive peculiar odour; they will be copious, liquid, rather pale, yellowish or drab in colour, with flocculi. A familiar descriptive comparison is to 'pea-soup.'

A week later, that is on the fourteenth or fifteenth day, the disease will have told obviously upon the patient. He will lie mostly on his back, and little on his side. The face, still flushed, and presenting often the red patches on the cheeks, will begin to look worn and thin; the eyes, still bright, will be less observant. The aspect and expression of the countenance are so characteristic as to be at once recognised by an experienced observer. The hand may be unsteady when held out, and there may be slight twitchings of the lips. There may be restlessness or even sleeplessness, and very often delirium. It has been stated that delirium mostly sets in about the twelfth day, but the time varies greatly. At first the patient is confused on waking from sleep, does not quite know where he is, and appears to have been dreaming, but soon collects himself; later he fails to shake off the confusion of thought, and he may talk incoherently, may ramble, in fact, as it is said. At this period the delirium does not go beyond slight rambling, and it is rarely violent at any stage. In severe cases there may be retention of urine.

The pulse will be more frequent, still less full, weaker; dicrotism is rarely well-marked. The lungs will not have undergone much change; the sibilant sounds may be more numerous.

The tongue will be more characteristic; the fur will be represented by a thin yellow or brownish streak down the centre, while the tip and edges will be red and angry. There will be a tendency to dryness, and generally the entire tongue looks shrunken and pointed.

The abdomen will be larger and more tense, and the tenderness and gurgling in the right iliac fossa more marked; the spleen will be larger. Now the eruption may be expected to present itself, if at all; but it must be remembered that it is absent in a considerable proportion of cases—a proportion estimated by some observers at 30 per cent. The eruption consists of small pink spots, about the size of a pin's head, slightly raised and pointed, well-defined, and disappearing on pressure, or when the skin is stretched, to reappear when the pressure is withdrawn. They are usually few in number, and are distributed irregularly over the abdomen and chest; but sometimes they are very profuse, the number having no relation whatever to the severity or character of the attack. The spots do not all come out at once, but in successive crops, till the end of the fever; the duration of individual spots, as observed by surrounding them with a ring of ink and dating them, being about four days. It has been recommended that the back should be searched for spots, but conclusions from eruption found here only would be untrustworthy, as the back is seldom free from spots, and there is nothing very peculiar in the spots of typhoid fever to distinguish them from others.

If the case is characterised by diarrhœa, it is usually at this period that it begins to be most troublesome; the stools have the appearances already described.

The temperature will be maintained at about the same height as at the end of the first week, but not uncommonly there is about this time a deceptive remission of fever, and it is perhaps worthy of remark that the active ulceration is now coming to an end. The fever which persists after this period has indeed been attributed to septic absorption from the intestinal ulcers—with doubtful justice, however.

It is from the latter part of the second week onward that complications, both local, such as hæmorrhage or perforation from ulceration and separation of sloughs, and general, such as pneumonia, are to be apprehended.

The end of the third week finds the sufferer at his worst. If he is now able to turn in bed and to lie on either side, and if other symptoms correspond with this indication of power, the case is favourable. In a severe attack he will lie on his back, and probably tend to slip down in bed. The face may be either pale or dusky; its look will be that of prostration. The patient is mostly very deaf, often dull of apprehension, so that he is with difficulty made to put out his tongue; he may be half unconscious, or in the condition of coma-vigil, a stuporous sleep with the eyes half open; or he may be restless, with muttering delirium, picking at imaginary objects in the air, or at the bedclothes. Sometimes the slightest pressure on any part of the body appears to give pain, or the patient may start in great alarm when spoken to. The body will be emaciated; the skin thin, pale, dry, and harsh; the muscles wasted; the tendons starting up, from sudden irregular muscular contractions (*subsultus tendinum*) when the limbs are at rest, while attempted movements are attended with jactitations and tremors; the lips tremble when the patient speaks, and the tongue twitches when protruded. A tap with the end of the finger on the pectoral muscle will cause a small swelling to rise on the spot—the so-called 'myoidema,' due to contraction of the degenerated fibres; it lasts for twenty or thirty seconds. The tongue is shrivelled, brown or even black, destitute of true epithelium, or dry and shiny, or coated with sticky slime or with black sordes. Sometimes it cannot be protruded at all. The roof of the mouth will be similarly coated; and there will be sordes on the teeth, and perhaps on the lips.

The pulse will be small, soft, extremely weak, often very frequent—130 or upwards per minute in bad cases; the beats run into each other, and are not distinct, giving the undulatory sphygmographic trace. The heart is extremely weak: the impulse absent, or a mere tap; the first sound short and feeble, or altogether extinguished. The lungs exhibit evidence of hypostatic congestion, impairment of resonance, and imperfect entry of air all over the posterior aspect of one or both sides of the chest.

The abdomen will usually be distended; spots may be present and continue to come out. There may or may not be diarrhœa. The stools may be passed unconsciously; and there may be retention, or more frequently incontinence, of urine. Bedsores often form rapidly, unless the nursing is both careful and skilful.

A tendency to recovery is usually indicated by improvement in the temperature, pulse, tongue, and abdomen. The temperature gradually falls, but at first this is shown chiefly by the increasing morning remissions, giving a greater difference between the morning and evening temperatures, and showing on the chart greater zigzags; the evening temperature then begins to fall day by day. The pulse becomes less frequent, and more full and distinct; the tongue gradually cleans, beginning at the margins; the abdomen subsides, the diarrhœa ceases; and strength returns little by little. In fatal cases the mode of death, when not due to some complication, may be by asthenia, or more frequently by coma and asthenia combined; hyperpyrexia is not uncommon as a phenomenon of the moribund condition; and, as the heart fails, hypostatic congestion of the lungs is usually very marked.

Relapses.—Relapse is very common in enteric fever. It usually occurs about ten days after the subsidence of the temperature in the primary attack, and is sometimes attributed to premature administration of solid food, but more commonly has no such cause. A true relapse is not merely a recurrence of pyrexia, but a return of all the phenomena of the fever. Fresh Peyer's patches are attacked, and there is frequently a fresh outbreak of the spots at about the same period after the initial symptoms, or often earlier. The relapse, however, is rarely as long as the original fever; very commonly, indeed, the third stage, that of so-called infective or pyæmic fever, is wanting; and when this is so, it is probable that there is no ulceration of the intestinal glands. Fortunately, also, it is not so often fatal as might be expected, seeing that the patient is reduced by the first attack. A second or a third relapse may take place; the writer has even indeed seen a fourth, the patient recovering, and surviving five distinct attacks of fever, each of which was severe. No satisfactory explanation of the relapse of typhoid fever has been given. It has been said that there is a re-infection of the subject by poison lodged in the mesenteric glands; but it is not easy to understand why he should be susceptible to the influence of the poison from this source, when for the most part the susceptibility to the disease is exhausted by an attack.

Special Symptoms and Complications.—These are so numerous and varied that it has been thought better to describe them separately, rather than to interrupt the account of the fever.

Hæmorrhage.—This occurs in about 6 or 8 per cent. of the cases. It may come on as early as the tenth day, but more commonly it is between the fourteenth and the twenty-fourth days, and in the later rather than the earlier part of this period; bleeding may be provoked by imprudence in diet, or by exertion later still. The hæmorrhage is due to the erosion of some vessel during the ulceration of Peyer's patches, without protective plugging by fibrin, or to vessels being laid open by the detachment of a slough. The quantity of blood lost, and the rate at which it is poured out, vary greatly. Sometimes the fact of hæmorrhage having taken place is only known by the stools being black, sticky, and offensive. At other times the blood is discharged in large clots, or it may be extravasated so rapidly that it is liquid and red, not having had time to become blackened and coagulated by the intestinal contents or secretions. When the hæmorrhage is considerable, the patient is rendered pale and pulseless. The temperature always falls, and not infrequently the loss of blood can be recognised before it appears in the stools by this fall of temperature, and by the pulse and general appearance of the patient. It is said that severe and persistent headache early in the attack is often followed by hæmorrhage in a later stage.

This complication is always attended with anxiety, and often exhausts the strength of the sufferer; but it is not by any means necessarily fatal. In many cases, indeed, the occurrence of considerable hæmorrhage marks the setting in of improvement; the temperature which falls on account of the loss of blood does not rise again; the patient becomes clearer and less heavy and oppressed; the tongue cleans; and all unfavourable symptoms gradually subside.

Perforation.—This, like hæmorrhage, may occur early, or at a late period; when early it is due to the entire thickness of the intestinal wall being implicated in the necrosis of the Peyer's patch, and the perforation may then be large. Later, at the end of the third week or afterwards, the perforation results from ulceration, and is often very minute. Unless adhesive inflammation at once glues the affected point to a neighbouring coil of intestine or to the abdominal wall, there is extravasation of intestinal gases and liquid into the peritoneal cavity, producing general and usually fatal peritonitis.

It might be expected that this occurrence would give rise to severe pain, but very often there is neither pain nor tenderness. The abdomen, however, rapidly becomes distended, often to an extreme degree; its walls are absolutely motionless in respiration; and on the application of the hand and making pressure, there is not only tension but resistance of a peculiar kind, which is highly characteristic. With the local symptoms there are evidences of shock: great anxiety of countenance, which may be flushed and beaded with perspiration, or pallid and livid; extreme frequency of pulse, often 140, 160, or 200, which is small and weak; and very great frequency of respiration. The respiratory distress is so marked that, in some instances which the writer has been called to see, the perforation had been overlooked, and the condition attributed to some lung-complication.

Peritonitis.—Peritonitis, without antecedent perforation, is an occasional complication of typhoid fever. It differs from the peritonitis caused by perforation in the more gradual onset, and in the less urgent character both of local signs and general symptoms—of the latter especially.

Tympanites.—Great distension of the abdomen by flatus is not uncommon in the course of typhoid fever, coming on independently of peritonitis or perforation. Most frequently it gradually appears late in the disease, together with other symptoms of prostration of the nervous system, but it may set in abruptly within the first week, and it is then prognostic of an early fatal issue. Simple tympanites is distinguished from peritonitic distension by the difference in the feel to the hand; but chiefly by the fact that the respiratory movements of the abdomen are not suppressed, though, of course, impeded. Absence of pain is so common in the peritonitis of typhoid fever, that it is no criterion by which to distinguish inflammation from tympanitic distension.

Diarrhœa.—As has been stated, the bowels are usually loose in typhoid fever. Not infrequently this looseness becomes excessive, and is thus a cause of exhaustion and a source of danger. Unless there is blood in them, the stools are more liquid, frequent, and copious, but not otherwise different from the usual typhoid motions.

Albuminuria.—Albuminuria is not uncommon as a complication of typhoid, and it may be accompanied with convulsions, though it is by no means so dangerous as in typhus. The albuminuria may be the effect of the poison or of the fever-processes on the blood, or it may indicate nephritis. In the former case, which is much more common, the urine does not differ in appearance from this secretion as usually seen at the stage of the disease at which it is present, and the albumen is only detected by examination; in the latter, the urine will be scanty and dark-coloured, as in desquamative nephritis when it is not a complication of typhoid fever.

Pneumonia.—Inflammation of the lung may come on early or late in the course of typhoid fever. When early, it is usually a lobar croupous pneumonia, not differing greatly from ordinary pneumonia; in the later stages it is often a combination of lobular catarrh with hypostatic consolidation. The symptoms are not marked. The temperature rises or is more sustained; there is increased frequency of the pulse and respiration, and perhaps obvious respiratory distress; the face may be flushed or anxious. As a rule, there is little or no cough or expectoration. Examination, when practicable, reveals the ordinary physical signs.

Pulmonary gangrene.—Gangrene of the lung may occur from obstruction of branches of the pulmonary artery by fibrinous coagula carried from the heart.

Pleurisy.—Pleurisy is occasionally met with as a complication of typhoid fever. It does not give rise to much pain, and may easily be overlooked, the condition of the patient precluding careful examination.

Thrombosis.—Thrombosis may be either a complication or a sequel of typhoid fever. It arises from the languid state of the circulation, and from the condition of the blood, which is liable to coagulate. The femoral vein and its branches are the vessels most commonly obstructed, the thrombosis usually beginning in the small deep-seated branches and extending to the larger trunks, so that there may be deep-seated pain and tenderness in the calf or in the gluteal region for a day or two before the large vein is affected.

Thrombosis gives rise to pain and swelling of the limb, with some œdema, and the vein can usually be felt as a solid cord; there is a new access of pyrexia, especially if convalescence have already set in.

Embolism.—Embolism by plugs of fibrin deposited in the heart, and subsequently launched into the arteries, may occur in any part of the body. Hemiplegia may happen from this cause in the course of typhoid fever; or occasionally, but very rarely, gangrene of part of a limb.

Parotitis.—Parotid abscess is less common in typhoid than in typhus fever; but it may occur in very severe cases, and is then an additional source of danger.

Sequelæ.—Enteric fever always leaves the patient weak, and the debility lasts long. This is due not merely to the waste of tissue by the protracted fever, but to the fact that the intestinal and mesenteric lesions interfere with absorption of nutrient material. In some cases the patient never recovers strength, but gradually becomes emaciated, and dies from asthenia or from some intercurrent attack. Occasionally the ulcerations do not heal, and they may prove fatal after the lapse of a considerable time. Phthisis, again, may be started by an attack of typhoid fever, usually, but not invariably, in an individual predisposed to the disease. Insanity is another occasional sequel; the most common form of mental derangement is melancholia, but there may be acute mania. It may come on almost immediately, the patient never appearing quite to recover his faculties after the stupor of a severe attack; or it may develop itself at an early or late stage of convalescence, or not till a still later period.

VARIETIES.—To complete the account of typhoid fever, some of the principal deviations from the ordinary course and type of the disease must be enumerated; and in the first place it must be understood that, both in individual cases and in entire epidemics, typhoid fever may run its course without rise of temperature, the characteristic lesions being found after death. Again, there is sometimes so little general depression of strength that the sufferer may walk about, and carry on his usual avocations up to a late period of the attack. The term *typhus ambulans*, or *ambulatorius*, has been applied to such cases. The writer has known several instances in which patients have *walked* into the London Fever Hospital with perforation.

Infantile Remittent Fever.—Infantile remittent fever is so called from the remissions often observed in typhoid fever affecting young children. No special description is necessary, the disease pursuing much the same course in children as in adults, only with greater fluctuations. Spots are less frequently seen.

Typhoid Fever with Constipation.—This really constitutes a distinct variety, the constipation persisting throughout, and not merely lasting for a few days and then giving place to diarrhœa.

Bilious Fever (*Fièvre bilieuse*).—This is recognised as a special form of typhoid fever by French observers, and deservedly so. The characteristic feature is frequent, sometimes almost incessant, vomiting of liquid containing bile, both after food and when no food has been taken. Severe headache often persists throughout the attack. The temperature does not, as a rule, rise high, and it fluctuates much; the face is pale and anxious; the pulse is frequent and very weak; the tongue is usually coated, and may be white or yellow. It is a very dangerous form of the disease, and may end fatally in ten or fourteen days by simple asthenia, without delirium or comatose symptoms.

Typhoid Fever with Meningitis.—True meningitis sometimes, though rarely, occurs at an early period of typhoid fever, and is attended with excitement, which may be maniacal in character, or violent delirium, and perhaps pain in the head.

Abortive Typhoid.—This is sometimes described as 'fourteen-day fever.' After well-marked symptoms of the attack, the temperature is not maintained, but gradually subsides. Such cases are mostly set down as common continued fever, or febricula.

DIAGNOSIS.—A well-marked case of enteric fever at the height of the disease is easily recognised by the aspect of the patient, and by the symptoms already described: the red tip and edges of the tongue, the tumid abdomen, the enlarged spleen, the rose spots, and the character of the stools. In the early stage, however, it is often necessary to suspend the judgment for a day or two, and there may be difficulty in forming a definite opinion for a much longer period. The diseases which have most frequently been taken for typhoid fever are tubercular meningitis, acute pulmonary tuberculosis, and gastro-intestinal catarrh; typhlitis, catarrhal pneumonia and other acute affections of the lungs, glanders, pyæmia, and ulcerative endocarditis, have also from time to time been confounded with it. On the other hand, typhoid fever may possibly be taken for one of these affections, or may more easily be masked by some complication, such as pneumonia or peritonitis. What is most liable to happen is, that it may be entirely overlooked.

The insidious onset of typhoid fever is very characteristic; and, as has been said before, the thermometric chart of the first four days showing a rise day by day with the morning remissions, might of itself suggest the diagnosis. But occasionally the invasion is abrupt, or there is some pulmonary complication at the outset, which raises the initial temperature, so that it would be unsafe to rely too implicitly on the temperature. The first thing to be done in establishing a diagnosis of enteric fever is to exclude local inflammation as a cause of the febrile condition, which will be effected by physical examination and other means. It must not be forgotten during this investigation that in pneumonia the consolidation may not occur for three or four days. When there is doubt, epistaxis will be evidence in favour of, herpes labialis against, such a diagnosis, though herpes may break out when there has been a rigor. The presumption of typhoid fever arrived at by excluding local inflammation and other acute diseases will soon be strengthened by the appearance of corroborative indications which we need not again specify, or be overthrown by their continued absence.

As regards the particular diseases enumerated as those with which it is specially liable to be confounded—in tubercular meningitis the temperature is not usually so high as in typhoid fever, the pulse is at first not very frequent, and is often hesitating, while it almost always presents the condition of tension, thus contrasting with the soft short pulse of fever. There are usually, but not constantly, headache and vomiting early in the attack, the bowels are mostly confined, and the abdominal wall is retracted. Squint, inequality of the pupils, or double optic neuritis, would be unmistakable indications of meningitis. In acute pulmonary tuberculosis there is more cough; and although at first there may be only scattered sibilant sounds, such as are heard in typhoid fever, these soon become more abundant, and other physical signs of the infiltration of the lungs are added, such as impairment of the resonance, and imperfect entry of air. The temperature also is usually more sustained. Gastro-intestinal catarrh in children is sometimes attended with so much febrile disturbance as to give rise to a suspicion, or even a diagnosis, of typhoid fever, especially as the abdomen is tumid, and there may be diarrhœa; over-feeding with milk may keep up the appearance of fever for some time. There are, however, intermissions and variations which, when carefully noted, are found to be inconsistent with continued fever; the tongue is more thickly and coarsely coated; and the stools, though they may be pale from undigested milk, have not the typhoid character. In typhlitis there is more local pain and tenderness, and a lower temperature; and the symptoms set in more abruptly, vomiting being common. It is unnecessary to enter upon the distinction between typhoid fever and the other diseases mentioned; for the most part a few days will clear up any uncertainty or confusion.

As a matter of fact, errors rarely arise, when it is deliberately considered whether a given case is or is not one of typhoid fever. The danger is that the idea of fever may not be entertained at all, its symptoms being attributed to some slight local ailment. Or there is pneumonia or peritonitis as a complication, when the patient first comes under observation, which is not very uncommon among the poor or in hospital practice. The possibility, therefore, that typhoid fever may underlie an acute local affection should always be borne in mind, and when the desired crisis does not come on in pneumonia, or if in peritonitis the general symptoms are not altogether those of inflammation of the peritoneum, indications of enteric fever should be carefully looked for. When, again, a patient complaining only of some functional derangement, or of weakness and loss of appetite, has a look of illness and prostration which is disproportionate to the assigned cause, enteric fever should be suspected.

There is often great difficulty in distinguishing *infantile* remittent fever from tubercular meningitis on the one hand, and from gastric catarrh on the other. In gastric catarrh the tongue is more loaded; the temperature is less sustained and more irregular; constipation is more common than diarrhœa; and the evacuations, whether solid or liquid, have not the specific characters, but consist more of undigested food. In meningitis there will usually be purposeless vomiting, but not always; the temperature is not so high; the pulse is often slow or irregular, and the respiration shallow and sighing; the abdomen is not distended, and may be retracted; the bowels are confined. A squint would at once confirm suspicions of meningitis.

PROGNOSIS.—It is never safe to speak confidently of the recovery of a case of typhoid fever, in view of the complications which may arise; but the prognosis is favourable or unfavourable, according to the antecedent condition of the patient, and to the severity of the attack, as estimated chiefly by the temperature. The mortality varies from 15 to 25 per cent., but there may be epidemics in which it may be throughout lower or higher than the average here stated.

Children seldom die of typhoid fever, and in the young the attack is less likely to be severe, and there is a better chance of recovery even when it is. In debilitated subjects, and especially in persons addicted to alcohol, typhoid fever is always attended with danger; even in a mild attack there may be failure of the heart, and pulmonary complications or thrombosis, which may prove fatal. Pregnancy also renders an attack dangerous. Apart from causes of anxiety in the general condition of the patient, and exception being made of cases in which the fever assumes the bilious type, attended with frequent vomiting of bile, headache, and prostration, and of the rare instances of meningitis as an early complication, the prognosis turns mainly on the temperature. If this is not more than 102·5° F. in the evening at the end of the first week, there is very little danger; on the other hand, if the evening temperature reaches 105° F., nearly half the cases prove fatal. When the temperature ranges high, it is of great importance to ascertain whether it is so for many consecutive hours, or only for a short period; a heat of 104° F. sustained for a great part of the day is a more serious matter than a brief rise to 105° F. On this account, and also because the maximum may be attained at different periods of the day, it is desirable that the temperature should be taken in serious cases every two or three hours, or even more frequently. In typhoid fever, as in other acute diseases, a contrast between the surface-temperature and the temperature of the blood, as revealed by the thermometer, is of unfavourable significance. If with high temperature there are indications of failure either in the nervous system or in the heart, the prognosis becomes serious; a tendency to stupor or retention of urine early in the disease is a bad sign; and acute tympanites at this period, indicating, as it does, paralysis of the muscular walls of the intestine, and presumably of the sympathetic nervous system, almost invariably points to a speedily fatal termination; the later gradual distension of the abdomen ranks with the unfavourable signs, but is often met with in cases which recover.

Unusual frequency of the pulse, marked dicrotism early, and extreme weakness of the beat and compressibility of the vessel later, intimate danger, as does also an increasing frequency day by day towards the end of the third week. When the beats run into each other, and the pulse is a mere flutter, the danger is immediate and extreme. The sounds of the heart should be noted throughout the disease; the first sound, as heard at the apex, tends to become, first, short and sharp, then weak, and it may altogether cease to be audible; a good or bad first sound is of good or bad augury respectively. A systolic apex-murmur is not uncommon, and occasionally a distinct presystolic murmur is heard; these murmurs have no great significance, and usually disappear as the patient recovers.

Treatment.—The principles on which the treatment of typhoid fever should be conducted are generally accepted and well understood. Success depends greatly on their intelligent application to individual cases, and on careful attention to details at every stage of the disease.

The patient should, if possible, be placed in a large, airy, and well-ventilated room, the windows and door of which should be more or less continually open, according to the season and weather. The bed should not be too wide, and it should be approachable on both sides, so that the patient can be easily reached from either hand; it should be firm, but comfortable. A feather or flock bed is very objectionable, on account of the hollow into which the patient sinks in it. When practicable, it is a great comfort to have two beds—one for day, the other for night. The covering should be light, but sufficient to protect the patient from changes in the external temperature; eider-down quilting, or any material impervious to the insensible perspiration, should be forbidden; the under-surface of such coverings will often be found quite damp, and exhaling an offensive odour. Conscientious, skilful, and efficient nursing is of the utmost consequence; and that nothing may be overlooked, a record should be kept of the condition of the patient, of the food, stimulants, and medicines administered, and of the evacuations passed.

The patient should be sponged night and morning with tepid water, to which a little vinegar, or eau-de-Cologne, or permanganate of potassium may or may not be added. The temperature of the water may vary, the feelings of the patient being consulted, and the effects in producing sleep and quiet noted. The hands and face may be washed or bathed frequently, and the general sponging may be repeated at any time when it seems to be required by heat and restlessness.

It is useful to habituate the patient to the use of the bed-pan from the first. It is true that very often the chair or utensil is used throughout; but in severe cases, or on the occurrence of hæmorrhage, the sitting posture is dangerous, and indeed impossible, and it may be most distressing to have to pass the excretions into the bed-pan for the first time under circumstances of extreme prostration; this may, indeed, destroy the patient's chance of recovery. A disinfectant solution should be placed in the pan or other vessel into which the stools are received, and more should be added before they are thrown away.

Perhaps the most important element in the treatment of typhoid fever is the regulation of the diet. This should be exclusively liquid, and the staple constituents will be milk, and beef-tea or broths of one kind or another. It should be borne in mind that these liquids are food, and not mere drinks, and they should be given with strict regularity. Two or three pints of milk, and a pint or pint and a-half of beef-tea or some equivalent, will be about the quantity required for twenty-four hours' consumption in the first instance; and it should be so divided that milk and beef-tea are given alternately about every three hours, judgment being exercised in waking up the patient if he is sleeping when food is due, or allowing him to sleep beyond the hour. The great tendency now, on the part of the public, is to over-feed cases of fever. When the patient asks for drink, milk is offered, and if it is iced or diluted with soda or seltzer water it is sufficiently grateful in quenching thirst to be accepted in quantity altogether beyond the digestive powers; it then coagulates in masses, escapes solution by the gastric and pancreatic juices, and passes down the intestine in heavy curds, which irritate the ulcerated surfaces, besides producing other disturbances. It is in this way that milk has been discredited as an article of diet. The writer's experience is in accord with that of the late Dr. Parkes, who looked upon milk as the typical diet for enteric fever. In later stages of the disease it may be necessary to give nourishment more frequently, but the attention of the medical attendant will in most cases be required rather to moderate the amount of food given than to urge its administration; it may, however, be found necessary to take precautions against neglect in this respect during the night. In emergencies, concentrated meat-extracts may have to be given in teaspoonfuls every few minutes. The patient should, of course, be allowed to drink freely of cold water, toast-water, or any simple drink. The key to the regulation of the diet—it may almost be said to the management of the patient—is to be found in the careful inspection of the stools; the medical attendant ought to see every evacuation, or, at any rate, one motion every day, supplementing his own information by the report of a trustworthy nurse. When curds appear in the dejections, either too much milk is taken, or too much at a time, or its digestion is interfered with. If the passage of undigested milk is not remedied, there will certainly be flatulence, discomfort, and restlessness, elevation of the temperature, and in most cases diarrhœa. When, without error in the administration of the milk, curds appear in the stools, dilution with soda or seltzer water, or the addition of lime water or bi-carbonate of sodium, may prevent premature and unduly firm coagulation; or the admixture of arrowroot, barley water, or gelatine may cause the curds to be subdivided, and thus ensure their digestion. A more efficacious method, however, is to peptonise the milk. This is to be done not simply by adding a peptonising powder or liquid, but by carrying out the precise instructions given by Sir William Roberts (*see* PEPTONISED FOOD). In some cases beef-tea excites diarrhœa, and, given in excess, it will almost always have this effect.

As the fever subsides, eggs beaten up, or lightly boiled or poached, may be added to the dietary. In all cases the return to ordinary diet must be made with great caution, bearing in mind the fact that there may be intestinal ulcerations unhealed, and it should be a rule that no really solid food be given till the temperature has been normal for a week; even at the end of this time it is not uncommon for the temperature to rise one or two degrees, after a moderate amount of fish or meat with bread has been taken.

It is an unfortunate aggravation of the sufferings in typhoid fever that fruit, which is so grateful when the mouth is dry and parched, cannot be given freely, on account of its liability to excite diarrhœa; but a few grapes may be permitted, care being taken that the skins and seeds are not swallowed, and the effects being carefully watched.

The question of stimulants is an important one. Here, again, the prepossession in the public mind is in the direction of almost indiscriminate administration of alcohol, and the importunities of friends may have to be resisted. The amount of brandy or wine given must therefore be carefully checked and controlled. In a large proportion of cases no alcohol is necessary from first to last; it is scarcely ever required in the early stages of the disease, except perhaps in drunkards; and at no period should it be given as a matter of routine, or merely because the case is one of fever, but only to meet certain definite indications. These are mainly evidences of weakness of the heart, frequent, weak, and fluttering pulse, and weakness or absence of the first sound of the heart. When, as is usually the case, the tongue is also dry, and the teeth and lips are covered and the mouth lined with sordes, the indications for the use of stimulants are unmistakable. The effects should be watched; when alcohol does good the pulse becomes less frequent, and of better strength and volume, and the temperature is usually lowered; an important indication also is that the odour of spirit is not detected in the breath. When very high temperature and other unfavourable prognostic symptoms set in very early, stimulants may be given without waiting for the conditions above-mentioned. Alcohol is again often required as an adjunct to the treatment of fever by the cold bath. The safest form of stimulant is brandy or whisky; the quantity needed will vary greatly in different cases; in some two or three ounces in the twenty-four hours will be sufficient, in others ten or twelve ounces may be required. It should be given in divided doses in, or immediately after, the milk or beef-tea.

It will be convenient to say here a word on the use of opium. Its employment in certain complications—tympanites, peritonitis with or without perforation, hæmorrhage, and excessive diarrhœa—will be described later; the question now is whether it is well to give it for the relief of sleeplessness and restlessness. In the writer's opinion, when the restlessness is not so far allayed by cold or tepid sponging as to permit of sleep, it is of great advantage to the patient to give ten or fifteen minims of laudanum at night, or its equivalent in some other form. The writer has not found it to interfere with the digestion.

In a large proportion of cases no medicine need be given from first to last, but effervescing salines are usually grateful; the mineral acids, at one time very largely employed, often seem in small doses to do good; and one or two grains of quinine may frequently be given with advantage. It should be understood that medicines are of less importance than food, and that they are not to be allowed to interfere with its regular administration. A gentle aperient, calomel or grey powder followed by a mild saline draught, at the outset is often useful, but it may be blamed for subsequent diarrhœa. In Germany and America the treatment is often begun by administering six or eight grains of calomel in two doses, and at an early period of the disease this is more likely to do good than harm, though the dose is unnecessarily large.

When treatment, other than the careful watching, nursing, and feeding which are sufficient in mild cases, is required, this should not be a mere matter of routine; and it may conduce to precision in meeting the various indications presented from time to time if an attempt is made to classify and distinguish them.

We can recognise, then, in the course of typhoid fever, effects attributable (1) to the action of the poison; (2) to the intestinal lesions; (3) to protracted high temperature.

1. The entire fever-process, with all its concomitants, is of course due to the action of the specific microbe, but certain effects appear to have a more direct relation with the poison than others. The immediate agents in the production of nearly all, whether direct or indirect, is a ptomaïne secreted or formed out of disintegrated proteids by the typhoid bacillus; and an important question bearing on treatment is whether the toxic material is formed entirely in the intestinal canal or also in the blood and tissues. It is apparently on the first of these two suppositions that the employment of mercury, iodine, carbolic acid, sulpho-carbolates, salol, salicylates, and other intestinal disinfectants suggested by the theory of the bacteroid origin of typhoid fever, has been based. Good results have undoubtedly been obtained, but not such as to invalidate the long-established conclusion that it is not within the power of medicinal agencies to cut short an attack of typhoid fever, or even to effectually modify its course. Undoubtedly ptomaïnes are formed in the small intestine, and this not only by the typhoid bacillus, but by other bacteria which find a congenial soil in the albuminoid exudations poured out by the irritated mucous membrane. It has seemed to the writer that this is the explanation of the dark and peculiarly offensive stools sometimes met with in the early stage of typhoid fever accompanied by a high temperature, and of the extraordinary oppression of the nervous system and depression of the circulation occasionally seen without high temperature, or distension or tenderness of the abdomen, or diarrhœa, or other indication of a severe attack.

These are, therefore, the cases in which intestinal antiseptics are indicated; and, according to the writer's experience, mercurial preparations are the most trustworthy. When the motions are specially offensive and accompanied by much gas, the abdomen being tumid and the temperature high, from a half to one fluid drachm of the solution of perchloride of mercury, with perhaps one or two grains of quinine, may be given every four hours for two or three days with excellent effects. When the nervous system is evidently overwhelmed by poison, while the abdominal symptoms are slight, the local lesions may be disregarded, and two or three grains of calomel may be administered once or on two successive days. The entire aspect of a case threatening to prove fatal may sometimes be changed by thus clearing out and disinfecting the intestinal canal. It will be remembered that two or three grains of grey powder were formerly given three times a day throughout the early part of the attack.

The formation of ptomaïnes in the blood and tissues is little, if at all, influenced by remedies. The chief and most characteristic effect is the rise of temperature; and this, when not aggravated by adventitious causes, is not controlled by antiseptics of any kind.

2. Severity of the intestinal lesions, as indicated by marked tenderness in the right iliac region, tumidity and tension of the abdomen, and diarrhœa, may call for opiate fomentations, and, when the motions are unduly frequent, for starch and opium enemata. Careful examination of all the stools is specially necessary in case of irritation by undigested milk, and for the early detection of sloughs and blood-clots which may give warning of hæmorrhage.

3. The great source of danger in typhoid fever is the prolonged high temperature; and it is to this, together with the fever poison or process, that are due the prostration of the nervous system and the weakness of the heart which are the most frequent causes of death. To keep down, therefore, the febrile heat of the body is to diminish very greatly the danger attending this disease. It was natural and inevitable that the remarkable class of drugs which have been found to have the power of lowering the temperature —acetanilide, phenazone, phenacetin, and the like—should be eagerly employed for this purpose in typhoid fever; but while an immediate effect can be obtained, it is only fugitive, and a continued administration is

usually disastrous. The most trustworthy means of controlling the temperature is cold bathing. The cold-water treatment of fever was, as is well known, originated by Dr. James Currie, and practised with marked success by him and many other distinguished and trustworthy physicians. Notwithstanding results obviously good, it fell into disuse, till revived by Dr. Brand of Stettin. Dr. Brand's method is to place the patient in water at a temperature of 65° or 70° F. whenever the temperature of the body, as taken in the rectum, reaches 102·2°, and to keep him there for ten, fifteen, or twenty-five minutes, until the heat is reduced 2°, or at any rate until he has been shivering for some minutes. Liebermeister takes 103° as the temperature which requires the bath, and this he does not make quite so cold, that is, 75° F., while he recommends ten minutes only as the period of immersion. The bath has to be repeated three, six, or eight times a day—as often indeed as the heat of the body rises to the point named; and it must be persevered with for two or three weeks or more, as may be required. A little brandy is given before or during the bath; and when the patient is taken out of the water he is placed in bed, dried, covered up, but not too warmly, and kept at rest (*see* HYDROTHERAPEUTICS). In order that the full benefit may be obtained from this treatment, it must be begun early, in which case the temperature need never be allowed to reach an injurious height; and it is claimed that the intestinal lesions are also held in check. When thus carried out, it must be taken as established that the mortality of enteric fever is very greatly reduced by the bathing. Jürgensen's statistics show a reduction from 15·4 per cent. to 3·1; Liebermeister's from 27·3 to 8·2 (this observer, however, employing quinine largely); others show a still larger fall; and it may be safely estimated that in France and Germany the deaths have been diminished by at least one-half. Dr. Cayley has shown that like results are to be expected in this country, and the writer's own experience is corroborative of his conclusions. If, however, the remarkable success obtained by Dr. Barr of Liverpool by the continuous bath—the patient being kept in water at a regulated temperature throughout the attack—is confirmed by general experience, this method ought to supersede all other treatment. Against the advantages of cold bathing are to be set off the difficulty of carrying it out, and the labour it involves; the prejudices of the public, and the dislike and dread of some patients; the facts that some cases may be protracted (which, by the way, might otherwise end fatally); and that relapse is certainly more frequent. These are good reasons for trying whether the same end may not be attained by other means; but unless we are successful in this, the duty of the medical attendant is to insist on the uncompromising employment of the cold bath. The graduated bath, in which the initial temperature of the water is 90° F., or, as the writer has found to answer the purpose equally well, 80°, is often more acceptable to patients, the water being cooled down rapidly to 70° or 65°. If the fever be high, and the nervous prostration great, conditions in which the shock of sudden cold is of great service, the cold water added to bring down the temperature may be poured over the patient's head. The cold wet pack and Thornton's ice-cap have been tried as alternatives to the bath, but without effects adequate to the requirements of the case. It has been hoped again to prolong the effects of the bath, and so render frequent repetition unnecessary, by the administration of large doses of quinine or salicylic acid. Quinine, to keep down the temperature for any considerable time, must be given in large doses—thirty or forty grains; and even this amount will, as a rule, produce no decided impression unless the way has been cleared by a bath. It is to be given, then, shortly after a bath in two or three equal portions within the space of about half an hour, and a little laudanum may be given with, or just before the quinine, to prevent vomiting. Very frequently the temperature remains depressed for twenty-four hours afterwards, sometimes even for a longer period. The patient often suffers from severe symptoms of cinchonism, but in view of the advantage obtained this need not be seriously regarded. Sometimes, however, violent and protracted vomiting is set up, which is an absolute bar to the further employment of quinine, except hypodermically. The neutral sulphate is the most convenient form for this purpose, and it is sufficiently soluble to be given in adequate doses, that is, of five or six grains. The writer's own experience tends to the conclusion that the frequent bathing has advantages over the combination of quinine with the bath, both as regards the safety and the comfort of the patient; though he has also seen cases in which the bath alone seemed inadequate, while with the aid of quinine the fever was kept down. He has twice seen severe tetanus produced by the bath and quinine, both cases, however, recovering. Salicylic acid and the salicylates have appeared to him to have a dangerously depressing effect. Of digitalis employed in large doses as an antipyretic, he has had no experience.

Without going so far as to say that the cold or graduated bath should be employed in all cases, the writer is of opinion that many lives would be saved were cold-bathing at once put in practice, whenever a temperature of 103·5° or 104° F. in the first few days shows that the attack is of more than average severity; and it is of the greatest importance that this should be done early, so that the pyrexia may never get the upper hand, and that the intestinal lesions may, if such a thing is possible, be modified. And no patient should be deprived of the chance which is afforded by the bath when, at any stage of the disease, life is threatened by hyperpyrexia or by consequences of high temperature, such as violent excitement, sleeplessness, restlessness, or nervous prostration. The only complications which render the bath inadmissible are hæmorrhage, peritonitis, and the advanced cardiac weakness and degeneration sometimes found late in the disease. Albuminuria or pulmonary affections do not constitute a bar to cold bathing. The writer has known albumen to disappear from the urine at once, and pulmonary congestion to clear up after a single bath.

Treatment of Complications. — We will now consider the treatment of the chief symptoms and complications. In severe and protracted cases a state of extreme prostration ensues which must be combated by special therapeutic measures. A feature of this condition is great frequency and weakness of the pulse, with loss of tension, so that the beats run into each other. Here digitalis may be of very great service, not only by diminishing the frequency and increasing the strength of the heart's action, but by giving tone to the vessels. Probably, however, the most valuable resource is the hypodermic injection of strychnine, which may undoubtedly save life. One-sixtieth to one-thirtieth of a grain may be given every three or four hours as long as necessary, the effect being carefully watched. Digitalis or ether, or both, may be combined with strychnine. Strychnine hypodermically is again the best remedy in the sudden intercurrent attacks of prostration which sometimes occur in the course of fever. The most careful watch should be kept for complications at all stages of the fever, but especially after the end of the second week. A rise of temperature must always be taken to have some definite significance requiring explanation. With increased frequency of respiration, it may be the sole indication of the accession of pneumonia or pleurisy. A fall of temperature may give warning of hæmorrhage. Retention of urine, though uncommon in typhoid as compared with typhus fever, should always be borne in mind; and unusual restlessness should at once suggest an examination of the hypogastrium. The passage of a catheter has often put an end to sleeplessness and excitement. Bed-sores ought never to occur, and it will conduce to their prevention for the medical attendant to inspect the sacral region and other parts where they are liable to be produced.

Hæmorrhage.—In the treatment of hæmorrhage the first thing to be done is to arrest the peristaltic action of the bowels by a full dose of opium; and as an immediate effect is required, one of the liquid preparations should be given—the tincture or liquid extract, and the dose may be from twenty minims to a drachm. The bleeding vessel has to be closed by a clot, and peristaltic movements will tend to disturb this, while it must be remembered that the blood poured out is a continued provocative of movements on the part of the intestine. Direct astringents which depend on local action are useless; before they could travel the whole length of the small intestine, and reach the bleeding point, they would be neutralised by combining with the intestinal contents. Physiological hæmostatics may be of more service. Ergotine hypodermically, or alternate doses every hour or every two hours of the liquid extract of ergot, ʒss to ʒj, and of turpentine ♏x–xv, have seemed to the writer to have most effect. Acetate of lead and opium or morphine, sulphuric acid and decoction of logwood, tannic acid, and all the known styptics have been recommended. An important adjunct—probably more effectual than any internal remedy except opium—is an ice-bag over the region of the cæcum; this at the same time quiets peristalsis and contracts the vessels.

Stimulants must be given if the patient is in danger of dying from syncope, but it must be borne in mind that fainting gives time for the vessels to close; and until the bleeding has stopped, this condition must not be too diligently averted. We must, in fact, sail as close to the wind as is consistent with safety. The same considerations apply to the administration of food: very little, if any, should be given by the mouth for twenty-four hours, nourishment being supplied by small nutrient enemata.

Perforation.—The only medicinal treatment likely to be of service is the administration of large doses (ʒj or more) of laudanum or the liquid extract of opium or an equivalent of morphine, hypodermically or by the mouth. This has saved life in a few cases, but in the immense majority of cases a fatal termination speedily ensues. Laparotomy may also be proposed.

Peritonitis.—Here, again, opium in repeated moderate doses is the most useful remedy; with poultices applied over the abdomen.

Tympanites.—Once more the remedy is opium, which should be given in pill three or four times a day when the distension is late and gradual; in very large doses of some liquid preparation when it is sudden. Charcoal has been recommended, but in the writer's experience it has rarely been other than hurtful.

Diarrhœa.—As long as the stools do not exceed three a day, or while they do not appear to distress or exhaust the patient, nothing special need be done to check the diarrhœa. It must always be borne in mind that beef-tea or other strong flesh-juices may excite diarrhœa; undigested curds of milk may have the same effect. As soon as undue frequency in the action of the bowels is observed, any possible cause in the diet should be eliminated; this failing, the best remedy is an opiate enema, twenty or thirty drops of laudanum in two ounces of thin starch. In most cases two or three enemata will arrest the diarrhœa; should this not happen, astringents must be given by the mouth—acetate of lead and opium or morphine, sulphuric acid, laudanum, logwood, or tannic acid.

Constipation.—This, whether intercurrent when there has been diarrhœa, or present throughout the fever, is a perplexing symptom. It is best relieved by enemata given every other day, but sometimes these are insufficient: a teaspoonful of castor oil may then be given, care being taken that any accumulation in the rectum which might give rise to difficulty of defæcation is previously removed by enema.

Bilious Vomiting.—When this is present from an early period of the attack, attended as it usually is by great prostration, it has seemed to the writer that life is endangered by the formation and absorption of some poisonous ptomaïne, and that the intestinal lesions are then of secondary consequence. Acting on this idea, calomel has been given in doses of two or three grains, in order to carry off the poison and disinfect the intestinal tract, with excellent results.

Albuminuria.—Nephritis must be treated by poultices and dry cupping over the kidneys. Albuminuria due to alteration of the blood requires no special treatment, and it is not a bar to cold bathing, but on the contrary may be among the symptoms calling for it. The disappearance of albumin from the urine, which is sometimes observed when the temperature has been reduced by bathing, seems to show that the blood-change is due to the pyrexia, and not to the poison.

Pneumonia.—When pneumonia sets in, stimulants are generally required, and the patient will derive benefit from bark or quinine, which may be given in the form of the ammoniated tincture. Turpentine in small doses, or the stimulant balsams, will often be found useful. Turpentine stupes are generally better than poultices.

Thrombosis.—Elevation of the leg on soft cushions, warmth, and gentle support by means of a flannel bandage, will be the treatment required.

W. H. Broadbent.

TYPHOID STATE (τῦφος, stupor).—Synon.: Fr. *État Typhoïde*; *État Adynamique*; Ger. *Typhose Erscheinungen.*

Definition. — A condition which may arise in the course of any febrile disorder, when the approach of death is gradual, and the rise of temperature either excessive or long-continued. The typhoid state is, however, most frequent in typhus, enteric, yellow fever, and pernicious malarial fevers; and in such cases the tendency is often evident from the very beginning of the attack.

Description. — The symptoms of the typhoid state relate chiefly to the nervous system, and indicate depression, not excitement. There is low muttering delirium, passing into stupor, with little or no true sleep (*coma-vigil*); with derangement of the senses, and hallucinations of sight and hearing. The urine and fæces are passed unconsciously, or there may be retention of urine. The sensibility of the skin is greatly impaired; flies may creep unnoticed even over the eyelids. General muscular weakness is shown, the patient lying on his back, sunk down in the bed. The lips and gums are covered with sordes, and the tongue is dry and black. *Subsultus tendinum* is present. The pulse is frequently of a running character, so that it is difficult to distinguish and count the beats; small and weak; sometimes irregular, and easily affected by slight causes, for instance, failing distinctly during inspiration. The heart's impulse is greatly weakened; the first sound almost or quite lost at the apex. The skin is dry, if, as is often the case, the temperature is high, 104–5° F. or upwards; or it is bathed in clammy sweats, which rarely prevail at one time over the entire surface. There is lividity of, or even ecchymoses on, the under-aspect of the trunk and limbs; and in the exanthematous fevers the eruption becomes petechial. The breathing is hurried and shallow; and towards the close frequently assumes the type known as Cheyne-Stokes respiration.

Pathology.—It is unwise to attempt to attribute all these different symptoms to one single cause. The chief primary cause may be the injurious influence of a high internal temperature upon the central nervous organs, but this same temperature acts directly also upon the parenchyma of glandular organs, and upon the muscular fibre, both of the heart (Stokes) and of the voluntary muscles (Zenker); and the disorder of the nervous centres must be greatly increased by, if not sometimes directly due to, the changes in the composition of the blood, and in the forces of the circulation.

Prognosis.—The prognosis of the typhoid state is always grave, but in fevers which run a definite course recovery may take place, even when the condition is fully developed, if it be so only at or near the crisis.

TREATMENT.—The treatment consists in the free use of stimulants. Of these brandy is the best, and may be given in doses of half an ounce every half-hour or hour; but the quantity must be determined not by measure, but by the effects upon the patient. If no improvement follows its exhibition by the mouth, frequently repeated rectal injections of brandy with egg or strong beef-tea ought to be tried. Musk, in doses of one to three grains, has been recommended, but the writer does not attach any value to this drug in these cases. The subcutaneous injection of five to fifteen minims of ether is often so successful in increasing the vigour of the heart's action, that it well deserves a trial here, too, if other means prove ineffectual. If the temperature is excessive, the cold or tepid bath, or the cold pack, should be used; but immediately before or during the application of external cold, half an ounce of brandy at least should always be given. The salutary effects of cold are maintained and increased by full doses of sulphate of quinine, such as five or ten grains of the sulphate every hour, until twenty or thirty grains have been taken. The writer cannot advise the use of salicylic acid or its salts in the typhoid state. External stimulating applications are not without value, for example, vesication by blistering fluid, or by strong solution of ammonia to the shaven scalp, when nervous symptoms predominate, or a flying blister to the præcordial region when the heart's action is seriously impaired. Throughout the typhoid state the patient's strength must be husbanded as carefully as possible; and the great object of the nursing should be to save him from the necessity of any mental or muscular effort whatever.

JAMES ANDREW.

TYPHUS FEVER (τῦφος, stupor).—SYNON.: Malignant Fever; Petechial Fever; Gaol Fever; *Typhus Exanthematicus*; Fr. *Typhus*; Ger. *Flecktyphus*; *Kriegspest*; *Lazarethfieber*.

DEFINITION.—Perhaps no better definition has been given in modern times than that which Hildebrand formerly assigned to typhus: 'Morbus acutus, febrilis, contagiosus, exanthemate proprio ac eminenti systematis nervosi passione stipatus.'

HISTORICAL.—Before describing this disease, which has been properly designated a scourge, a historical sketch of its ravages may not be devoid of interest. It is more than probable that typhus and other analogous forms of fever have existed from the earliest times, and that, as surmised, the plague of Athens described by Thucydides was the disease under consideration. Be that as it may, it was noticed as a new disease by Frescatoro, imported into Italy in 1501 from Cyprus.

Sir John Pringle, whose opportunities for the study of the disease were extensive from 1742 to 1745, has given an excellent description of the camp fever as it prevailed in the English army at that period.

Not only has typhus raged in armies—more especially in defeated armies, often following retreating hosts like a shadow, as was witnessed in the Grand Army in the retreat from Russia—but also in prisons, as the epidemic of Toulon, and notably in English prisons before the reforms initiated by the philanthropic Howard were carried out. It was found that the overcrowding and filth of gaols generated typhus, and were the cause of epidemics marked by extreme malignancy. Ireland has been looked on as the favourite habitat of typhus fever, the *Brutstätte*, the land of fever; so it has been termed by Virchow 'das Land des Hungers, des Fleckfiebers und der Auswanderung.' It may be observed in passing that Ireland fortunately no longer answers to this disparaging description. True it is of the past, for more than a century and a half widespread and devastating epidemics have swept over the land uninfluenced by change of season. Other countries were the seat of similar visitations. In many countries it has been sporadic and epidemic—in Russia, in Poland, and in many provinces of Germany, in Rhineland, in Hanover, in Berlin, Breslau, in Holland and Belgium.

ÆTIOLOGY.—Having briefly sketched the history of typhus, it now becomes necessary to inquire into its causes and modes of propagation.

All experience goes to prove that food, bad in quality and deficient in quantity, is the most potent predisposing cause of fever; the late Sir Dominic Corrigan, in his *Famine and Fever*, gives convincing proof of this fact. All the great epidemics of fever in Ireland and elsewhere have followed times of famine, owing to bad seasons and failure of the crops. It has been assumed on high authority that typhus is a hunger fever, but against this view a protest must be entered. That want and misery, and consequent mental depression, overcrowding, and dirt, render the person susceptible and a ready recipient of the poison must be admitted. But that there is a something in the air—'a contagium vivum,' a typhus miasma, which, taken into the system, produces fever—must also be admitted. Up to the present, the most ardent and able investigators have failed to discover the presence of a fever-producing parasite in typhus, such as has been found in some infective diseases. After Obermeier's discovery of the presence of spirilla in the blood of relapsing fever (*see* MICRO-ORGANISMS) research was stimulated with a view of discovering a fever-producing parasite in the blood of typhus; and indeed Hallier proclaimed that he had found a micrococcus in typhus which he supposed to be specific, but Klebs and others, according to Mosler, have failed to verify this statement.

Koch, in his most important communication to the Medical Congress at Berlin, included exanthematic typhus in the group of infective diseases in which research has been fruitless of results.

The poison, whatever it may be, is present in certain localities, causing endemic disease, and under favourable conditions assuming the epidemic form.

Can it arise spontaneously, independently of infection? To this question an affirmative answer must be given, fortified by the fact that all infective diseases must have had a beginning. The origin of the disease spontaneously is doubted by Professor Mosler, who mentions many sources of contagion little suspected as carriers of disease, such as dirty paper-money, or coins. There is no disease, with the exception of small-pox and scarlatina, which is admittedly more infectious than typhus fever.

In Ireland the question has many years since been set at rest by the essay on the 'Origin and Latent Period of Fever,' by Sir Henry Marsh, published in the *Dublin Hospital Reports*, in which that eminent observer accumulated a mass of evidence which incontrovertibly proved how communicable is the disease. Cheyne's reports of the Hardwicke Hospital are also replete with facts pointing to the same conclusions. The physicians of the Hardwicke, with scarcely an exception, were seized with fever; so it was in other fever hospitals. The dispensary medical officers in many parts of Ireland during epidemics fell victims to the disease. All, or nearly all, who came frequently near the infected—physicians, students, nurses, and the women who washed the clothes, all who had not previously had the disease—were stricken down. The writer experienced it in his own person, as did many of his predecessors and colleagues in the hospital. He was in the act of examining the chest of a patient in fever when the person was suddenly seized with a fit of coughing; he was so placed at the moment that he must have inhaled the breath: the odour was intolerably offensive. He was certain he had imbibed the poison, and after a latent period of three days he exhibited the usual train of symptoms which usher in fever of the severest form. It is worthy of notice that the exposure took place when he was weakened by not having had food for many hours, and when he was not in perfect health. So it was in the case of Marsh, who gives a graphic description of his own seizure. The greater number are not conscious when they are poisoned by the typhus miasm, but the exceptions are not rare. Marsh perceived on suddenly turning down the clothes of a patient, a highly disagreeable odour; he was oppressed, and at once overwhelmed *uno ictu*, being conscious at the time of having absorbed the poison.

PRODROMAL OR LATENT PERIOD: PERIOD OF INCUBATION.—The time intervening between exposure to infection and the advent of the series of phenomena constituting fever is generally from three to seven days; but it may be shorter or more protracted. There may be no incubation—*typhus siderans*; the overt symptoms at once appearing, as it were, simultaneously with the reception of the poison. The incubation period is not generally a time of health: sleep is disturbed, there is often a malaise, an undefined sense of illness, a depression, and often a fear of some impending calamity. The patient may struggle against it, and follow his ordinary occupations, until it becomes impossible to further resist.

SYMPTOMS.—The symptom which ushers in the disease is generally a rigor, a sensation as if cold water were trickling down the back—a feeling well remembered by the writer, although many years have elapsed. There may, however, be no distinct rigor, merely a *frisson*, a chilliness; and even this may not be noticed. There may be one distinct severe rigor, or a number of slight shiverings. After the rigor a rapid rise of temperature takes place; and now, if not before, the patient is in most cases compelled to take to bed. The symptoms then are headache, giddiness, heaviness, languor, dulness, pain in back and limbs—especially the thighs, sleeplessness or disturbed sleep, thirst, inappetency, tongue loaded, white or yellowish, perhaps nausea or even vomiting.

The early symptoms are at times so slight that the affected person may be able to walk about; and in three, four, or seven days defervescence takes place, and restoration to health follows. This is termed 'febricula'—*Febris ambulatoria* of the Germans. In by far the majority, however, the symptoms become aggravated day by day; sometimes catarrhal symptoms supervene—often they are the earliest manifestations. Headache is complained of, with intense flashes of light before the eyes, or intolerance of light; the skin, at first red, assumes a dusky hue; the tongue becomes brownish and dry. On the fourth or fifth day of the fever the rash (the exanthem to which the disease *typhus exanthematicus* owes its name) appears. This rash is generally first observed on the trunk, then spreads to the extremities, rarely on the backs of the hands and face. The spots vary in size from a slight speck to three or four lines; sparse at first, they soon extend; isolated or grouped together, they have been compared to pieces of marquetry; they may be of an intense red, but generally they are pale; little papillæ are seen in some few cases. The typhus exanthem bears a close resemblance at its commencement to the rash of measles; hence it is often termed 'measly eruption.' The spots disappear on pressure. In the space of two or three days the eruption is complete; the colour gradually assumes a more or less dark hue, livid or mulberry, no longer disappearing on pressure. The usual duration of the rash is from a few days to fourteen or fifteen days. Its colour is often deeper on the back than elsewhere; and when a doubt exists as to its having appeared, it should be looked for there.

The rash does not seem to have any influence on the fever, and it may continue after the defervescence; but the more copious it is, and the deeper its colour, the more severe is the disease. This is the opinion which is held by most observers. The change of the eruption from measly to true petechiæ or cutaneous hæmorrhages is the rule. The skin in the course of the disease may be the seat of various epiphenomena—erysipelas, furuncles, sudamina, œdema, abscesses, or gangrene of the parts most exposed to pressure; and sometimes even the nose and the genitals are affected. In some epidemics icterus occurs, and its appearance has in some cases been remarkably sudden. The febrile phenomena are not mitigated with the development of the rash.

It sometimes happens that towards the end of the first week there is an amelioration of the symptoms; but this is but a lull in the storm in the greater number of cases. The temperature, which had fallen, rises again, and often exceeds the former record. The pulse attains a frequency of 100 in the morning, and 112 to 120 in the evening, and in the severest cases far exceeds this. In the early stages it is fairly full, but it may become weak, compressible, and fluttering; or, which is perhaps a more evil omen than great frequency, slowness is observed, owing to the diminished power of the ventricle to make every contraction felt at the wrist. The patient lies on his back and in a state of great prostration; there is a tendency to slip downwards; the headache of the early days has been succeeded by delirium, the character of which varies much. At first, chiefly at night or on awaking from disturbed sleep, he is confused and unable to answer questions correctly; at the end of the first or beginning of the second week the delirium becomes more pronounced—noisy, restless, or apathetic—and often the strangest phantasies arise. A fixed idea may take possession of the mind; muttering delirium, coma vigil, sopor, suddenly furious mania alternating with sopor; difficulty of restraining the patient in bed; hence necessity of closest watching, especially at night. The tongue is dry, contracted, and black, covered with fuliginous deposit — parrot tongue — as are also the gums. Retention occurs from paralysis of the detrusor vesicæ, or involuntary discharge of urine; and the bladder should be examined frequently, as the discharge is sometimes merely an overflow; for days it may be necessary to employ the catheter; the urine is high coloured, scanty, and often albuminous. Such are the symptoms of typhus in its severe form.

Towards the fifteenth or twenty-first day, in, fortunately, the great majority of cases, a favourable change takes place. There is no disease in which the change may be so sudden from a state of extreme danger. The patient, who had been violently delirious, or lying in a torpid state of low muttering delirium with subsultus tendinum, falls into a tranquil and profound sleep which may last for many hours—so long that it is necessary to awaken him for nourishment; and on awakening the temperature may be normal or below it, the tongue moist, the pulse—which had been rapid, thready, and tremulous—firm and moderate in frequency, and intelligence to a great extent restored, with returning desire for food and drink. This change—crisis by sleep—is the most favourable event. The skin, which was burning hot—*calor mordax*—may become moist, bedewed with a gentle sweat; and this seems in some instances critical, altogether different from the copious sweat which, occurring at an earlier stage, is almost always indicative of danger. A change, too, occurs in the urine which has been considered critical: it has been high-coloured and albuminous, or even bloody, and now the secretion is abundant, of normal colour, or even paler than natural, with a copious deposit of the lithates and phosphates. To this change in the urine the term 'crisis by urine' has been given.

COMPLICATIONS.—Many are the dangers and difficulties from complications which threaten the patient in the course of typhus, and prolong the disease; one of the most common is implication of the respiratory organs. In some epidemics so frequent is *bronchitis*, that the disease has received the name of 'broncho-typhus.' From the onset there may be a bronchial affection unmarked by the ordinary symptoms, even in advanced stages—no expectoration, perhaps not much acceleration of breathing; it may involve the whole extent of the bronchi (bronchiolitis), even producing atelectasis; its presence being only discoverable by auscultation. It is noteworthy that secondary affections in typhus are more or less latent. Broncho-pneumonia, hypostatic *congestion*, diffuse *pneumonia*, are among the most formidable complications in fever, and often indicate a lethal termination. Multiple *abscesses*, or *gangrene* in various situations, not confined to the parts exposed to pressure, may occur. *Convulsions* may usher in a fatal termination. Sudden death has occurred when all seemed to progress favourably.

DIAGNOSIS.—There are cases of typhus the course of which is normal, and which present no difficulties to the experienced physician in arriving at the diagnosis, and hence it is said the disease is easy of diagnosis; but he will meet with others, in which, to say the least, it is doubtful, nay, impossible. It is well to realise these difficulties, which are met not only in the slighter cases, but also towards the fatal termination of others, when even the necropsy throws no light upon the nature of the disease, the results being absolutely negative.

The poison which is so potent in its effect to destroy life, may leave no trace behind which is characteristic and pathognomonic, distinguishing it from other acute diseases, as enteric fever, malignant measles, encephalitis, meningitis, pneumonia, puerperal fever, icterus gravis, or pyæmia, and even from some chronic diseases which towards the end exhibit symptoms closely resembling those of typhus, and consequently are termed *typhoid.* Wunderlich strongly emphasises this: 'In dem Gange des Flecktyphus tritt nicht eine einzige Erscheinung auf, welche nicht auch in manchen andern Krankheiten vorkommen könnte, und die tödliche Katastrophe zeigt nichts was dem Flecktyphus allein zukommt.'

Recognising these facts, it is satisfactory to know that such cases are not frequent, and that typhus pursuing its ordinary course is easy of recognition.

The fevers with which it is most likely to be confounded are enteric and relapsing fever, both of which are found to exist in company with typhus in many epidemics of the latter. Cases of enteric fever may be wanting in the characteristic changes in the intestinal canal and the glands; and, again, typhus may exhibit changes resembling those of enteric fever, and so the two may, as it were, shade into each other. The knowledge of the exposure to either disease will assist very much, for typhus never gives rise to enteric nor enteric to typhus. Important aid also in the diagnosis may be obtained by observation of the temperature: marked elevation of temperature is noted in typhus from the onset, and the rapidity of the rise and the shortness of its duration exclude the idea of enteric. The typhus course resembles relapsing fever in the first days. In both of these diseases the temperature is high; but it is higher in relapsing fever, and on the fifth or seventh day defervescence takes place, and the patient is for the time fever-free, to be followed by a new access of fever. Other febrile diseases seldom maintain so high a temperature as typhus for so long a period, for either the severity of the disease kills, or a fall takes place. The return of the temperature to the normal from fever-height in typhus is often very rapid, the defervescence, as before mentioned, taking place in one night.

Comparing typhus with enteric fever, the defervescence is extremely rare at so early a period in the latter, or at so late in an acute exanthem or in relapsing fever. These observations on the temperature, which are so valuable and trustworthy, are due to the researches of Wunderlich. The rapid fall of the temperature in typhus, as compared with the gradual decreasing fall in enteric, is also a distinguishing feature. The profuse petechial rash contrasts strongly with the sparse and rosy spots of enteric fever, usually coming out in successive crops, and elevated. The absence of epistaxis and intestinal lesion, also of hæmorrhage and of marked splenic enlargement; as a rule, absence of diarrhœa of the peculiar character, which is almost pathognomonic of enteric fever; the absence, too, of ileo-cæcal tenderness and gurgling; and the rarity comparatively of meteorism, all are to be taken into consideration. In both the respiratory and circulatory organs are liable to be implicated, and so are the kidneys.

It has been affirmed that no single symptom proclaims the presence of typhus; but the order in which the symptoms are presented, the congress of symptoms, and the disturbance of the nervous system, powerfully aid in arriving at the diagnosis.

PROGNOSIS.—In forming a prognosis of typhus fever, the character of the epidemic, and the rate of mortality, may first be taken into account. Some epidemics are peculiarly mild and benign, others are malignant in the extreme. The period of the epidemic is also important, as the earliest cases are generally most fatal. Then the condition of the infected, if previously in broken-down health, ill fed, ill clothed, ill housed—such fall ready victims to the pestilence; perhaps nothing renders the prognosis more unfavourable than habits of intemperance. As for the upper ranks of life—persons who have lived in comfort, and who have been regular in their habits, and previously in fair health—the following are circumstances which tend to cause the disease to fall heavily upon them: if engaged in anxious business transactions, if the mind is on the stretch, and the nervous system is early engaged; such cases have received the popular name of 'brain fever.' Sex-mortality is also to be noted, being greater in adult men than in women. The symptoms indicative of danger are the early existence of delirium alternating with stupor, the peculiar affection denominated 'coma vigil,' subsultus tendinum, and other low nervous phenomena.

Very high or very low temperatures, and

extreme rapidity of pulse, always proclaim the severity of the disease and consequent danger. It has been observed, however, that in no disease is high temperature so well borne as in typhus. The character of the pulse is one of the most reliable indications of danger. To rapidity may be added irregularity, feebleness, compressibility. The opposite state, however (slowness) is also of evil augury; for the first sound of the heart may be absent, and the impulse diminished in force or absent—conditions of the heart indicating the need of wine and other stimulants, as first pointed out by Stokes. Great tympanitic distension is another indication of danger; and the presence of rash of the deepest hue.

Other conditions which add to the danger in typhus fever are weakness or paralysis of various parts; hypostatic congestion, which may end in gangrene of the lung; strabismus; and contraction of the pupil; spasm, convulsion, stiffness of neck, utter unconsciousness, automatic movements; and, above all, advanced age.

The prognosis in uncomplicated typhus is favourable; in early life the mortality is moderate. It is not so great in women, unless when they are pregnant. Danger increases after passing the meridian of life; a quarter and even half of the cases between fifty and sixty years of age succumb. In some epidemics the enormous mortality of 40 or 50 per cent. has been reached, contrasting remarkably with the low rate of others—of 5, 6, or 7 per cent.

Anatomical Characters.—It is admitted by all who have had the most extensive opportunities of investigating the disease, that there are no anatomical changes which can be considered pathognomonic of typhus. Lebert asserts with truth: 'Kein Organ ist jedoch der besondere und Hauptablagerungsherd der Krankheit.'

If death takes place early the body is little emaciated; the petechiæ which are caused by blood-extravasations are visible, and, as in life, most marked on the back. Almost all the organs of the body are the seat of change in structure, congestions, and fatty degenerations. The liver, spleen, and kidneys are the seat of more or less degeneration. The mucous membrane of the intestinal tract is infiltrated, and shows traces of catarrh, and in exceptional cases even superficial ulceration, but there is nothing constant. The brain and membranes in the early stages are hyperæmic; if death occurs late in the disease they may be anæmic, with serous effusions. The heart-walls are softened, and the seat of granular fatty change; there is fluid blood in the ventricles. The lungs are the seat of hypostatic congestion, the blood being profoundly altered—dark, almost black. The veins and arteries have been found to be the seats of thromboses and emboli. In the event of complications already alluded to, numerous are the lesions from which they arise.

Treatment.—Impressed with the communicability of typhus, it is the duty of the physician to insist, if possible, on the isolation of the sick from the healthy. The neglect of this precaution has often been followed by lamentable consequences. On the first approach of fever the patient should be ordered to bed. Every exertion, mental or bodily, at the commencement of the disease should be forbidden. The transport of the sick of typhus in war has been known to intensify the symptoms; so it is, too, in civil life. Therefore removal from the locality where first attacked, when the disease has made any progress, should be avoided, unless under the stress of absolute necessity.

In the management of typhus cases, in hospital or private practice, an abundant supply of air should be afforded. From the chamber all unnecessary furniture should be removed; the covering of the bed should not be too heavy. In summer the windows should be open, and in winter the windows of adjoining rooms, with open door between. The temperature of the apartment should not be under 59° F. nor over 65° F. During the height of the fever, when the temperature is high, exposure to cold does not act injuriously; but not so once defervescence has taken place. The patient should not be permitted to change from the prone position for any purpose—an order often difficult to be enforced during the early period of the illness. The strictest injunction should be issued against noise, or even whispering, in the room. Light should be modified, but not excluded. The patient will sleep better if the room is not darkened during the day. A marked difference should be made between day and night; this has been strongly insisted on by Corrigan in his admirable lectures on fever. No one should be admitted to the room except the necessary attendants.

The disease having been established, can it be cut short by any means? It is not possible when the poison has been taken into the system. For long it was supposed that bleeding, emetics, and cold affusion were potent factors in suddenly arresting the progress of the disease; purgatives have also been a popular remedy, and the administration of an active purge at the onset of fever has often had an unfavourable influence on the whole progress of the case. The idea of arresting typhus fever by such means is now altogether abandoned.

The disease in uncomplicated cases, when of moderate severity, runs a certain course, tending towards a favourable termination, and then the treatment is absolutely expectant. Nevertheless the watchful care of the physician can do much in steering the ship through troubled waters into a haven of safety, avoiding the rocks and shoals which threaten to submerge it. The regulation of the diet is of paramount importance. Thirst is constantly felt, and the craving should be satisfied, and the fancies of the sick, when possible, be indulged. Cold water or some mineral water will generally be found to be most acceptable; when the tongue is dry, iced water or ice may be permitted. If the patient's sensibilities are so blunted that he cannot give expression to his wants and wishes, care must be taken that at regular intervals drink and nourishment be given; no more suitable drink than milk and water or soda-water, can be given, thus supplying nourishment at the same time that the thirst is assuaged. No longer is the fever patient destined to be kept on *diète absolue—Fieberdiät*. It is now universally recognised that the waste must be supplied by suitable nourishment. In Great Britain and Ireland the example was set, which has since been followed in France and Germany, clinical physicians in the foremost rank in these countries admitting frankly that there was ground for the charge made against them of starving their patients. So speak Niemeyer and Trousseau. Broths of different kinds are now freely allowed, and, when there is great debility and manifest failure of strength, more concentrated nourishment, as essence of meat, or eggs. The administration of wine and stronger alcoholics is one of the points in the treatment of fever demanding the most careful consideration on the part of the physician, for upon it may depend the issues of life or death; but some patients do not require wine. In most cases, unless in those stamped by malignancy from the commencement, it may be postponed to the end of the first or beginning or even the middle of the second week, and then cautiously, tentatively given, marking its effects. The selection of the stimulant should depend upon the age and previous habits of the patient: the young or previously temperate require wine in small quantities, and diluted; the aged or intemperate a liberal allowance of strong wine or even brandy. Without reference to the day of the fever, if there be prostration, a tendency to sinking of the vital powers, stimulants must be freely given; and thus it may be that the threatened paralysis of the heart is warded off. Medicinal agents, such as ammonia, ether, musk, and camphor are often advisable.

When wine agrees, it will be found that the pulse, which was weak and shaky, acquires strength and falls in frequency, and the delirium is mitigated, for stimulants often exercise a calmative influence inducing sleep. The heart, which, from its weakness or paralysis, calls for the most strenuous efforts to sustain its flagging force to bridge over the danger which is so imminent, may recover its natural force. The cerebral symptoms—headache and delirium—are frequently relieved by the application of ice or, what is sometimes more effectual, cold or tepid affusion. Care should be taken, when the ice-bladder is employed, that it should not remain too long on the head, as it seems to have a depressing effect. When insomnia is present, and the temperature is high, tepid affusion often has the effect of inducing sleep; so has the abstraction of a small quantity of blood from the temples, sleep often coming on while the blood is flowing. The practice of general bleeding in fever followed by Sydenham and by Pringle even in gaol fever, and in a modified manner by many eminent physicians of wide experience, as Cheyne and others, in the epidemics of the early years of the present century and even later, has fallen into disuse; but the withdrawal of a little blood locally (two or three leeches on each temple) is not only unobjectionable, but is a remedial measure of the greatest value. In conditions of a comatose nature blisters should be employed—straps of blisters on the vertex, and not to the nucha, the part usually selected, but which should be avoided. If insomnia continues, the use of the bromides may be resorted to, and often with advantage; but when they fail, as they may, then opium or morphine must be administered. Dr. Hall has found sulphonal a remedy of much value, but it often has a depressing effect.

The application of water to the head has been spoken of, but in all cases it is also essential for the whole body. The most scrupulous cleanliness is to be observed, and sponging with cold or tepid water may be used when the antipyretic treatment by cold baths has not been fully carried out—a practice now so generally followed in Germany in the treatment of enteric fever, and for which are claimed by its advocates, Liebermeister and others, such satisfactory results. This treatment is now being adopted in typhus also, in which, as in other cognate diseases, the danger of high temperature is universally admitted in combating the very essence of fever, which Galen termed 'calor præter naturam.' The practice, although it originated in England, has not hitherto in this country been adopted to the same extent as on the Continent and in India. The importance of the reduction of the temperature which is menacing life cannot be over-estimated.

Quinine has been looked on by some as a specific, not only in malarious, but in continued fever, and has been used extensively since first recommended as an antipyretic by Vogt. Liebermeister recommends it in colossal doses, and says he now treats no serious case of typhus without it. Quinine is used as an adjunct to the cold bath in the antipyretic treatment of fever; it may be the sole antipyretic when the cold bath is contraindicated. Mosler, who had the experience of two epidemics of typhus, attributes the low mortality of the second to the fact of the antipyretic treatment having been by him more energetically carried out in that epidemic than in the first.

It has been stated, in contrasting maculated typhus with enteric fever, that in the former the bowels are generally confined; the best means of removing this state is by warm or cold water enemata, which never cause over-action, which even mild aperients by the mouth often do. One of the most dangerous complications in fever is meteorism, and the best means of combating it is by the internal and external use of turpentine. Another is bed-sore, which in low forms of fever, despite all efforts to guard against it, will sometimes appear. The back should be examined daily, and the surface, which has become red, should be bathed with brandy or camphorated spirit; the position of the patient should be changed, and air or water cushions placed under the back, or a water bed employed. In all cases it is most desirable to have two beds; a change can be effected without difficulty or danger, and the comfort and advantage of a day and night bed are incalculable. It is most difficult at times to limit the ravages of bed-sores, the nates have literally sloughed away, but even in such a case recovery has taken place.

The local applications which answer best are carrot poultices with charcoal, or stimulating poultices calculated to promote the throwing off of the gangrenous parts. Dry gangrene may be allowed to remain undisturbed, as it is a protection to the subjacent parts. The danger of hypostasis has been alluded to, and this may be averted by altering the position of the patient, and also by the free administration of wine or brandy to stimulate the heart's action.

The use of quinine as an antipyretic has been mentioned; and it may be added that it is the most reliable remedy in some of the complications of fever—above all in typhoid pneumonia, as recommended by the writer's distinguished colleague, Dr. Gordon. Independently of its effect in pneumonia, quinine seems to have almost a specific influence on the muscular tissue of the heart, for it has been often found that under its influence the weak, irregular, and fluttering heart has become regular.

The physician must be always on the watch for complications, for their approach is generally insidious, and wanting in the symptoms which in ordinary cases appertain to them; they may be truly termed latent. The restoration to health after ordinary typhus is rapid; but typhus protracted beyond its ordinary duration leaves the patient's bodily strength at a very low ebb, and sometimes the brain does not speedily recover from the shock it has received. Mania may be a sequel, but the form of cerebral disturbance is more frequently characterised by mental weakness, with inability to fix the attention and follow any train of thought. The prognosis is generally favourable, for usually in time the mind recovers its wonted vigour.

JOHN BANKS.

TYROSIN (τυρός, cheese). — SYNON.: Fr. *Tyrosine.*—Tyrosin, or para-oxyphenyl-*a*-amidopropionic acid, is, like leucin, with which it is generally associated, a decomposition-product resulting from the prolonged action of the pancreatic secretion on the complex proteid molecules. Its chemical composition is represented by the formula $C_9H_{11}NO_3$.

CHARACTERS.—Tyrosin crystals are soluble in acids and alkalis, but very sparingly soluble in cold water, much more soluble in hot water, and practically may be considered insoluble in ether and strong alcohol.

Microscopically, tyrosin crystals are usually seen in the form of very fine needles, either separate, or occurring in feathery or wheatsheaf bundles (*see* fig. 103).

Chemically, tyrosin may be obtained from the urine by the method described under LEUCIN, but the residue of this, insoluble in boiling alcohol, is treated with boiling water, and allowed to crystallise. The most reliable and delicate reactions for tyrosin are the two following:

Piria's Reaction.—Warm on a water bath for about five minutes a watch-glass containing tyrosin moistened with concentrated sulphuric acid; a pink colour is produced. Dilute with water, warm, neutralise with barium or calcium carbonate; filter whilst hot. Add to the filtrate a few drops, carefully avoiding an excess, of a weak solution of the perchloride of iron. A violet coloration is indicative of the presence of tyrosin.

Hoffmann's Reaction.—If to a heated solution of tyrosin a little Millon's reagent be added, the fluid assumes a rose-red or crimson colour; and if tyrosin be present in quantity, a precipitate of a similar colour will be thrown down.

PATHOLOGICAL SIGNIFICANCE. — Tyrosin, according to Kühne, is never present in healthy livers; it, however, is probably normally present in very small amount in the pancreas and the secretion of this gland, and in the spleen. It is never a normal constituent of the urine; but its presence in this excretion along with leucin is of value diagnostically in certain morbid states of the liver, especially acute yellow atrophy, in which the secreting cells are quickly disintegrated. It has also been detected in the urine in cases of acute poisoning by phosphorus. *See* LEUCIN; LIVER, Atrophy of, Acute Yellow; and MICROSCOPE IN MEDICINE.

JOHN HAROLD.

U

ULCER and ULCERATION (ἕλκος, *ulcus*, a sore).—SYNON.: Sore; Fr. *Ulcère*; Ger. *Geschwür.*

DEFINITION.—A solution of continuity on an epithelial or endothelial surface, secreting pus.

ÆTIOLOGY.—A breach of surface may arise from external causes, such as mechanical violence, chemical irritation, heat and cold, continued pressure, and the like; on the other hand, changes may commence within the tissues themselves, owing to some general or constitutional cause, and a breach of surface, dependent upon acute or chronic inflammation or defective nutrition, be the result.

ANATOMICAL CHARACTERS.—The parts of a healing ulcer are—the *surface*; the thin blue epidermic *pellicle*; the *edges*; the *surroundings*; the *discharge.* When an ulcer departs from the healing type, every possible variety of appearance occurs in the surface, edges, surroundings, and discharge, and in the character and intensity of the accompanying pain.

When a section of an ulcer is examined microscopically, the following parts are made out: A layer of free leucocytes or pus-corpuscles on the surface; projecting up into the pus are fine points, consisting of loops of blood-vessels, coated over with living white corpuscles, constituting granulations; beneath this, a zone of inflammatory tissue, consisting of fine connective or dense fibrous tissue, varying according to the age and character of the affection. Marginally there is a zone of hyperæmia, fading away into healthy tissue beyond, where the blood-capillaries are very numerous, and the white blood-corpuscles are in excess.

Should the whole of the affected part be seen on a vertical section, it would appear depressed in the centre; and each zone, from the surface downwards, would appear as an arc of a greater circle than the previous.

The history of the commencement of an ulcer will evidently vary, according as it originates (1) from *external*, or (2) from *constitutional* causes.

1. When a *wound* does not heal by primary union, by scabbing, or by first intention, it begins in a few hours to show signs of active hyperæmia. The surface exudes first serum, then white blood-corpuscles, fibrinous and albuminous matters; the surroundings become congested; by-and-by granulations appear in the bottom of the wound, and an ulcer is thus established.

2. When the changes commence *within* the tissues, the general affection finds expression in some local irritation, causing a determination of blood to the part. The irritation may be a varicose vein, a gumma, a strumous gland, or a malignant tumour. The blood-vessels at first exude serum, which infiltrates the neighbouring tissues, causing them to swell. White blood-corpuscles and fibrinous matters after a time escape from the capillary walls, and the irritated spot becomes permeated by an embryonic connective tissue. The tissue thus formed passes, as the result of chronic irritation, to a higher state of development, becoming fine fibrous tissue, and as it becomes more dense contracting upon the structures passing through it. The consequences of such a change as this in any part are, first, an increased activity of its normal functions; and, secondly, a perversity and a gradual cessation of these functions, followed by destruction of the tissue from the arrest of nutrition.

A section of the part in this condition would show the irritating spot in the centre, then a zone of indurated fibrous tissue, and around all a zone of hyperæmia. When the skin becomes involved it changes colour, the epidermis is shed rapidly, serum oozes out through cracks and fissures, and finally may collect on the surface to form a scab. When the scab falls off, a raw surface, consisting of the papillary layer of the skin, is seen, and from this a discharge flows away, becoming thicker and more purulent. The surface is now an open sore, secreting matter, and exists as an ulcer.

PATHOLOGY.—**Ulceration.**—The ulcerative process is so intimately associated with inflammation, suppuration, gangrene, phagedæna, granulation, and cicatrisation, that it is impossible to detach it from any one of these, and call it a separate definite process. Few writers agree in their descriptions of the extent of the process, some looking upon the ulcerative process as implying destruction of the tissues only; others, as signifying both destruction and repair. In its widest sense, the ulcerative process is the process whereby ulcers are formed, spread, arrested, maintained, and healed. The actual formation of an ulcer has been discussed; and when the ulcer is once established, the ulcerative process is seen to be a liquefaction and dissolution of the tissues and exuded elements, and the formation of granulations and discharge. This process goes on from the beginning to the end of the history of an ulcer, so that it is impossible to say that it ends before healing takes place.

In the immediate neighbourhood of any ulcer, vascular changes take place, which have to be followed closely before the ulcerative process can be understood aright. In the first place, the capillaries in the neighbourhood of the irritated spot are in a state of tension, from increased blood-pressure, and they tend to relieve themselves by the transudation, first, of serum, and then of white blood-corpuscles and fibrinous material. These products behave differently, according as they escape into the *surrounding tissues*, or reach the *surface*.

(*a*) When the cells and fibrinous materials escape into the *surrounding tissues*, they infiltrate the immediate neighbourhood of the ulcer, causing a surcharge and œdema of the connective tissues. The consequent pressure on the blood-vessels leads to interference with the circulation, and, as a result, to a deficiency of the nutrition of the surrounding tissues. The cellular elements of these tissues swell, undergo degeneration, liquefy and are absorbed, or remain in the tissues. According to the intensity of the irritation and the condition of the patient, so the area of infiltration and of liquefaction extends, and the degenerative process continues; or, on the other hand, along with the infiltration, induration occurs, and stays the processes of destruction. The arrest of the extension of infiltration, by the formation of a moderately firm barrier of indurated tissue, is necessary before repair sufficient to heal the ulcer is induced.

(*b*) The portion of the cellular transudation that reaches the *surface* consists of two parts. The part for which sufficient nutrition cannot be obtained flows away as pus, whilst the part that is retained in close proximity to the blood-vessels becomes formed into a layer of embryonic connective tissue. This layer, as the irritation declines in intensity, increases in thickness, becomes vascularised, and rises into small protuberances constituting granulations. The vascularisation of the embryonic connective tissue keeps pace with the continued addition of new cells on the surface, and so the reparative action is kept going. The deeper layer of first-formed cells now become spindle-shaped, with their long axis parallel to the blood-vessels. Along with the blood-vessels, lymphatics and sympathetic nerves find their way into the granulations. The spindle-shaped cells gradually form a denser tissue, and, owing to their shrinking, the granulations diminish in size, the purulent secretion grows more scanty, and by-and-by the whole surface is involved in cicatricial tissue, and glossed over by an epithelial pellicle (*see* CICATRISATION). The details of this process will vary according as the destructive or the reparative process predominates; the predominance of the former will cause ulcers to spread, forming inflamed and phagedænic ulcers; whilst the predominance of the latter will tend towards the healing of ulcers.

That an ulcer heals by the building up of new tissue is much to be doubted. The ulcer comes to the same level as the surroundings, not so much, if at all, by the growth of its granulations, as by the subsidence of the swelling and induration in the edges and surroundings themselves. Before it can heal, these must be restored to a normal state; and it is only when this takes place, and the same level is reached, that the epidermis advances and glosses over the fibrous tissues of the cicatrix.

VARIETIES.—No better classification of the varieties of ulcers than Syme's can be given. All writers on surgery, since his time, follow the spirit, if not the letter, of his classification, and it is proposed to adopt this system here, noticing in order the following varieties of ulcers: (1) The *healing* or *healthy*; (2) *those that do not heal from defect of action*; (3) *those that do not heal from excess of action*; and (4) *those that do not heal from peculiarity of action.*

1. The healing or healthy ulcer.

The surface is covered by granulations, which are small and sensitive, and bleed when smartly touched. There is a thin, blue, epidermic pellicle, consisting of the epidermis advancing from the edges and over the surface. The edges are on a level with the surface, of a pink tint, and free from induration. The surroundings are free from induration, and normal in appearance. The discharge consists of healthy laudable pus. The pain is inconsiderable.

TREATMENT.—The treatment consists in helping the healing process by local and constitutional means. The local means consist, first, in rest, by position, or by splints or bandages: and, secondly, in the application of a piece of lint dipped in water or slightly stimulating lotion to absorb discharge and protect the surface; over this a piece of oiled silk slightly larger than the piece of lint, to prevent evaporation; and then a bandage or piece of strapping over all, to fix the dressing and support the part. Should the healing of the ulcer flag, stimulating lotions are required to restore the tone. If the ulcer has involved a large amount of skin, the process of skin-grafting hastens the cure, and is an efficient means of helping the cicatrisation. The patient's general health must be attended to, and the appearance of any retrograde change in the part will serve as a guide to such treatment.

2. Ulcers that do not heal from defect of action.

(*a*) *Weak ulcer.*—The cause of this form is generally the prolonged use of emollient applications. The characters are: The granulations become flabby, watery, gelatinous masses, and rise above the level of the surroundings, constituting 'proud flesh.' The edges are overlapped by the granulations. The surroundings are normal. The discharge is thin and watery. There is little or no pain.

TREATMENT.—It is necessary to get rid of the exuberant granulations by caustics, such as nitrate of silver or pure nitric acid. Afterwards we must employ astringent lotions, or powdered substances, such as oxide of zinc, oxide of zinc and starch, tannic acid, or nitrate of lead, with firm bandaging. When at the same time the patient's health is lowered in tone, tonics and bitter astringents must be given freely.

(*b*) *Indolent, callous, or chronic ulcer.*—This sub-variety occurs when, from chronic irritation, the fibrous-tissue induration is excessive, the blood-vessels reach the surface of the ulcer in too minute quantities to build up healthy granulations, and so the ulcer is perpetuated.

The surface is sunk below the level of its surroundings, is destitute of granulations, and looks glazed. The edges are raised, hard, and irregular. The surroundings are indurated, raised, and the veins in them frequently become varicose. The discharge is thin, serous, and small in quantity. The pain at times is very great, especially at night.

TREATMENT.—The induration is got rid of by strapping tightly and evenly with soap or resin, or a mixture of soap and resin, plaster; holes must be made in the plaster to allow the discharge to escape, and the strapping should be re-applied every forty-eight hours. At each removal, the surface may be touched with caustics, or washed with a strongly stimulating lotion, as of carbolic acid 1 to 20, or chloride of zinc 20 grains to the ounce. When the induration is gone and granulations appear, the ordinary treatment for a healthy ulcer is all that is required. Another method is to blister the surface of the ulcer with plaster or solution of cantharides; to apply a poultice over all, allowing it to remain for six hours; and on removal of the poultice, to wash the part with carbolic acid lotion 1 to 20, and apply antiseptic dressings (*see* ANTISEPTIC TREATMENT). Still another method of treatment is by the elastic bandage; this is used for the lower extremity only. The part is first washed with carbolic acid 1 to 20, and the limb bandaged firmly and evenly with Martin's elastic bandage, from the toes upwards, covering over the ulcer. No dressing is placed over the ulcer. The bandage by continued pressure causes softening, liquefaction, and absorption of the hard surroundings; and the surface of the ulcer is bathed in the natural secretion of the part. The bandage is removed nightly, washed with carbolic acid, hung up to dry at a distance from the fire, and re-applied in the morning. During the night a simple dressing is worn. For old-standing ulcers multiple concentric incisions through the dense tissues about them are of much value. The incisions are made parallel to the margins, but not sufficiently near to cut the blood-vessels going directly towards them. The incisions are to be kept open by strips of linen, when it will be found that the infiltrating serum escapes, affording relief of tension.

3. Ulcers that do not heal from excess of action.

(*a*) *Irritable ulcers.*—These are met with on the legs of nervous and anæmic women. The surface is uneven, covered often with a grey slough. The edges are irregular. The surroundings are red and glazed, but not thickened. The discharge is a thin sanious pus. The pain is excessive, of an aching kind.

TREATMENT.—In the treatment of irritable ulcer it is necessary, first of all, to relieve pain by giving opium hypodermically or internally, and applying opiate or lead lotions externally. At the same time an endeavour is made to restore the patient's health and tone. When the pain has ceased, the ulcer is treated by some one of the above methods.

(*b*) *Inflamed ulcers.*—Any form of ulcer may become inflamed. This sub-variety usually arises during the course of an indolent ulcer, from derangement of the patient's health, and local irritation.

The surface is covered with a greenish-grey slough. The edges are swollen, everted, red, and angry. The surroundings are red, swollen, and hot. The discharge is ichorous, offensive, often bloody, and causing irritation wherever it touches. The pain is of a throbbing kind.

TREATMENT.—The inflamed ulcer should be treated by rest, with bread-poultices properly applied; by three or four leeches, around the sore; or by scarification of the edges, which will allay the inflammation. After this the ordinary treatment previously recommended is to be followed.

4. Ulcers that do not heal from peculiarity of action.

(*a*) *Phagedænic and sloughing ulcers.*—When an inflamed ulcer commences to spread, the edges liquefy and rapidly break down. The process may take place with extraordinary rapidity, as in chancre, when it is called phagedæna; or as in hospital gangrene, when it spreads chiefly by sloughing. The patient in either case is usually in a cachectic state; the ulcerated part is dusky red, angry-looking, hot, and painful. The surface is covered by a grey or black slough, and the edges are sharply cut and undermined. *See* BUBO, VENEREAL; GANGRENE; and VENEREAL SORE.

Treatment.—Rest, opiates internally, and externally in the form of lotions, and careful dieting are necessary to subdue the spread of the inflammatory action. Prolonged immersion in water, which is kept constantly renewed, is an excellent method of treatment. Should these methods not control the action, the application of strong nitric acid will often succeed. Fresh air and disinfectants are required; and opium to relieve pain.

(*b*) *Varicose ulcers.*—The points to be observed about a varicose ulcer are that it follows the chronic irritation of a varicose vein; that when formed it may become indolent, inflamed, irritable, &c.; and that it frequently bleeds, from the ulcerative action extending towards and thinning the wall of a vein. *See* Veins, Diseases of.

Treatment.—Varicose ulcer itself is to be treated by the ordinary methods, but the varicose vein must be supported by an elastic stocking, or, what is better, when the ulcer is in a healthy state, by a Martin's elastic bandage.

(*c*) *Hæmorrhagic ulcers.*—Hæmorrhagic ulcers occur in persons suffering from amenorrhœa, scurvy, chronic jaundice, or hæmophilia. They possess the characters of irritable ulcers, but in addition have a special tendency to ooze blood from the surface. The blood is of a capillary-venous character, and flows freely at times.

Treatment.—In the hæmorrhagic subvariety we have to attend to the diathesis with which this special form of ulceration is associated, and treat the ulcer by any one of the usual methods.

(*d*) *Syphilitic*, *lupoid*, *rodent*, *scorbutic*, *endothelial*, and *mucous* ulcerations.—These are described in separate articles.

One form of ulcer possesses so much interest to the practitioner that it calls for special consideration.

Bed-sore.—Synon.: Fr. *Décubitus*; Ger. *Decubitus*; *Wundliegen.*

Definition.—A form of ulcer caused by continued pressure, consequent on the recumbent position.

Ætiology. — Bed-sores are dependent either on a low condition of the nutrition of the tissues of the patient, on bad nursing, or on a combination of the two. In patients suffering from fractured spine, especially if the spinal cord be torn; in those paralysed from other causes; in cases of fractures of the lower extremity; in angular curvature of the spine; in patients suffering from hip-joint diseases; in the acute specific fevers; and in the aged—in fact, in any disease or condition necessitating long confinement to bed, and rest in one position—bed-sores may be developed. When, in addition to the illness, the nursing is badly conducted, as shown by urine, pus, blood, or any discharge whatever being allowed to remain on the part where the patient lies, a strong determining cause is set up, which will in all probability originate a bed-sore. Other strongly predisposing causes are the use of a feather bed, and the presence of a blanket between the mattress and the under-sheet, into which the perspiration from the patient's body soaks, causing the blanket to act like a poultice. Hence it will be seen that paralysis and an enfeebled state of the circulation, combined with pressure and inattention to strict rules of cleanliness, are the main elements present in the production of a bed-sore.

The various sites on which bed-sores form are arranged here in the order of frequency with which they are met—the sacrum, the heel, the buttocks, over the trochanters, between the shoulders, on the middle of the back from the shoulders to the sacrum, on the malleoli, on the elbows, and on the calf of the leg. On the heel the usual cause is the pressure of a splint; on the elbow bed-sores frequently supervene in such cases as hip-joint disease, owing to the tendency patients have to support themselves on one or both elbows.

Anatomical Characters.—A bed-sore is only one of the many forms of the evil results of pressure. The passage of blood through a part where pressure is great becomes mechanically difficult. Exudation from the blood-vessels takes place, causing the cuticle to be first raised, then to peel off, and finally a moist catarrhal surface results. By-and-by stagnation of the blood in the blood-vessels occurs, and as a consequence the part becomes practically dead. In the surrounding parts the blood-vessels become engorged; and, the presence of the slough acting as a foreign body, the irritation causes inflammation, and an exudation of inflammatory products occurs between the living and dead parts. This takes place all around and beneath the slough, but is first apparent as a furrow on the skin. This furrow gets gradually deeper and deeper, and, the process of separation extending beneath the slough, it becomes detached and finally thrown off. An ulcerating surface now results, the further history of which will vary with the patient's health, and according as the illness, which rendered confinement to bed necessary, is of a curable or an incurable nature.

Symptoms.—The premonitory symptoms of bed-sore may be either subjective or objective. Subjectively the patient complains that the bed feels hard, that there is a crease in the sheet, that there are crumbs of bread or salt in the bed; along with these generally imaginary troubles, a pricking numbing sensation is felt at the point of pressure; but on examination of the part complained of, no change may be apparent. Or, again, the complaints may be *nil*, as in the paralysed, and yet the effects of pressure may be far advanced. The objective symptoms, that is, the changes apparent in the part, may be, as in the paralysed, the first indication of the effects of pressure. These are—alteration in the colour of the skin, a roughening of the cuticle, and a variable amount of pain on pressure with the finger. Any of these is sufficient indication that preventive measures must be immediately undertaken, otherwise a bed-sore will develop. As the symptoms advance, the discoloration becomes deeper, passing from red to livid red, from purple to black. The pain, except in the paralysed, becomes for a time severe, and then finally disappears, as all nervous connexions are severed. The circulation through the part being completely stayed, a dark slough is formed, and a line of demarcation between the living and dead tissue is set up. A foul discharge runs from the part; the tissues around become red and congested; the edges are undermined; and a feeble attempt is made to throw off the central slough. Should the slough be thrown off, the muscles, fasciæ, and even the bone of the damaged part may be exposed. The general symptoms associated with bed-sores are chiefly those of the disease in the course of which this complication has supervened. In some instances a form of pyrexia may, however, be induced by the discharging ulcer itself—a condition which constitutes one form of 'bed-fever.'

Diagnosis.—The appearances described in the skin, at the point or points of pressure, are unmistakable evidence either of the likelihood of a bed-sore developing, or of its actual presence.

Progress and Prognosis.—Should the patient recover from the illness for which confinement to bed had become necessary, the bed-sore will in all probability heal. Bed-sores, however, can scarcely be healed in those patients whose maladies do not improve, or in whom recovery does not take place. At times pyæmia supervenes; or the exhaustion, consequent on a long-continued and profuse discharge from the sore, proves too great a drain on the patient. The prognosis in regard to bed-sores developing in any individual case will depend on the disease, the age of the patient, and the care taken in nursing. The patients in whom a bad prognosis might be given, in regard to the appearance of a bed-sore, would be the old, and the partially paralysed, especially when bad nursing is superadded.

Treatment.—It is necessary to consider this subject under the heads of (1) the *preventive* measures; (2) the treatment *when abrasions have taken place*; and (3) the treatment or cure of the *sore when formed.*

1. The *preventive measures* have, in paralysed patients, and in patients suffering from incontinence of urine, to be commenced at the beginning of the illness, and signs of changes in the skin are not to be waited for. The part must be thoroughly cleaned, the circulation stimulated, the skin hardened, and pressure removed from the parts where it is greatest. The best means by which to gain these ends are as follows. First, the part is to be washed with soap and water, and then thoroughly dried. Secondly, a piece of cotton wool dipped in spirits of wine, eau-de-Cologne, or brandy, must be applied to the part with gentle rubbing, until it has become thoroughly dry; and this process must be repeated three or four times at each dressing. Thirdly, to keep the skin supple, a very small quantity of oxide of zinc ointment or simple ointment must be rubbed into the part, until all greasy feel has disappeared. Fourthly, a draw-sheet must be placed beneath the patient, and oxide of zinc powder sprinkled on the part on which the patient is to lie; the sheet must be changed the moment it becomes wet, whether from urine, blood, pus, or sweat. Pressure must be removed by frequent changes of position, and by suitable pads, air-cushions, water-pillows, or water-beds. The part where the edges of the cushion press is to be treated by the same preventive measures, and to be dressed two or three times a day. Lastly, we must avoid a feather-bed, and a blanket beneath the under-sheet. In many cases bed-sores are caused by careless nursing, but in others the best nursing possible cannot prevent badly nourished tissues from falling into decay.

2. When *abrasion* or roughening of the cuticle occurs, the same precautions in regard to pressure, moisture, and the use of the draw-sheet have to be observed; and, in addition, some specific applications are used. Sometimes the part is greased over with zinc or simple ointment; this is useful in certain cases, preventing urine or other irritating fluid from touching the tender parts. Over an abraded portion, soap plaster spread on amadou or linen is applied; at other times collodion or flexible collodion may be used. The best fluid applications are rectified spirit, or camphorated spirit, with one-third water; it is necessary to add water owing to the pain caused by pure spirit. The surface may also be mopped over with a solution of two grains of perchloride of mercury in one ounce of spirit; or with one consisting of five grains of nitrate of silver to an ounce of water.

3. The treatment of the *bed-sore itself* consists in keeping the part sweet; in aiding the removal of the slough; in applying some one of the many stimulant and antiseptic lotions in use; and in preventing the neighbouring tissues from breaking down. To clean the parts, and hasten the removal of the slough, apply a bread-and-water poultice, or a compress of wet salicylic or boric acid wool. When the discharge is foul, the

part should be washed with Condy's fluid or perchloride of mercury lotion (1–2000) between each application of the poultice. Poulticing may be unadvisable, as the heat and moisture tend to soften and weaken the parts, and permit of their rapidly breaking down.

Stimulating and antiseptic dressings are employed in one or other of the following methods. Cut a piece of lint the exact size of the sore; soak it in some stimulant and antiseptic lotion, such as carbolic acid, 1 in 40, or the red lotion, or the compound tincture of benzoin, the balsam of Peru, or the tincture of myrrh or of catechu; and apply it exactly within the edge of the sore. Over this place a piece of oiled silk or guttapercha tissue, a fraction larger than the lint used; and over this again three or four large folds of lint or amadou, with a hole cut in the centre corresponding to the sore.

In place of the folds of lint and amadou, circular pads or water-cushions might be used to take the pressure off. When the slough is large, lotions and poultices should not be applied directly to it, as the moisture only favours putrefaction. To prevent this, dry the sloughing surface with absorbent wool; dust it over with iodoform, iodol, or ordinary dusting powder; place a piece of oiled silk or guttapercha tissue exactly over the powdered slough; and the lint, dipped in one of the above-mentioned lotions, when applied over it, can only touch the sore at the ulcerating furrow between the living and dead tissue. All dressings should be fixed by diachylon plaster, and not by a bandage, owing to the heat and moisture engendered by use of the latter.

The neighbouring tissues must be treated with the preventive measures already mentioned.

When the slough has separated, an attempt is to be made to heal the part by improving the patient's general health, provided the existing malady permits. The usual precautions have to be taken with the surrounding parts; and the ulcer treated by one of the methods recommended under the head of Ulcers that do not heal from Defect of Nutrition. JAMES CANTLIE.

UMBILICAL REGION.—This is the central region of the abdomen, corresponding to the umbilicus and its vicinity. The principal structures which normally lie underneath it are the great omentum, and part of the transverse colon and small intestines, with the deep structures situated in front of the spine. The stomach may reach the umbilical region when distended after a meal.

CLINICAL INVESTIGATION.—There is nothing special to be said on this point, the ordinary methods of abdominal examination being applicable in the investigation of the umbilical region. The following points may be noticed with regard to the abnormal conditions met with in this region.

1. When the stomach is diseased, it is often so distended as to reach the umbilical region. The liver also, either when enlarged or displaced downwards, frequently extends to this region. More exceptionally the spleen or kidney may attain such a size as to encroach upon it. Enlarged organs or tumours may also ascend thus far from below, as in the case of the uterus and ovaries; and even a distended bladder may rise to this height.

2. In general enlargement of the abdomen the umbilicus and its vicinity often give useful information in determining its cause. Thus, when the enlargement is due to fluid in the peritoneum, the umbilicus tends to become stretched, everted, obliterated, or pouched out, which is not the case in other forms. In some instances of portal obstruction it not only projects, but has a peculiar appearance and feel, due to the presence of enlarged and thickened veins. Moreover, the percussion sound in this region remains tympanitic, and sometimes even excessively so, when the rest of the abdomen is universally dull. On the other hand, when the enlargement is due to an organ or tumour, this is not observed, and the umbilical region is often dull when the flanks are resonant. An important element in the diagnosis of ovarian tumour is often thus afforded.

3. Should a very small quantity of fluid be present in the abdominal cavity, this may be detected by placing the patient on his hands and knees, when the fluid gravitates towards the umbilical region, and can be discovered there by percussion.

4. The umbilicus itself may be the seat of disease, such as inflammation, eczema, or gangrene. These conditions are most important in infants, and soon after birth peritonitis may be set up by the extension of irritation from the umbilicus inwards. It, with the adjacent portion of the abdominal wall, is also sometimes involved in tubercular or malignant disease of the peritoneum, which spreads along the remains of the umbilical cord, causing thickening, hardness, redness, and other changes in the umbilicus. The region may likewise become fixed to the underlying great omentum, so that it cannot be moved.

5. Umbilical hernia is an important form of hernia. It may attain a very large size. Moreover, in connexion with this condition, much thickening and induration may be met with about the umbilicus, as the result of a chronic inflammation.

FREDERICK T. ROBERTS.

UNCONSCIOUSNESS. — Loss of mental perception or consciousness. *See* CONSCIOUSNESS, Disorders of.

UNDERCLIFF, on the South Coast of the Isle of Wight.—Extends from Bonchurch to Niton. A mild, tonic climate. *See* VENTNOR; and CLIMATE, Treatment of Disease by.

UNILATERAL FACIAL ATROPHY.—SYNON.: Progressive Facial Hemiatrophy; Neurotic Facial Atrophy; Fr. *Aplasie Lamineuse Progressive*; Ger. *Prosopodysmorphie.*

In this very rare affection the whole or part of one side of the face becomes notably smaller than its fellow, owing to an atrophic condition of the subcutaneous tissues and of the skin, together with atrophy of the muscles (though occasionally these escape) and of the bones on the affected side of the face. It is generally unassociated with pain or any alteration of sensibility in the affected region. The skin becomes thin, and pale from absorption of pigment, and hair either fails to develop or drops out. A remarkable and characteristic appearance is produced. The affection is to be distinguished from a congenital inequality of the two sides of the face which sometimes occurs, though to a minor extent. It commonly begins in childhood, and nearly always before the twentieth year, gradually spreading from some limited area in the cheek or other part. It may progress slowly but steadily for several years, and then remain stationary during the rest of the patient's life, which it does not tend to cut short in any way.

The pathology of this rare progressive atrophy of one side of the face has given rise to much discussion. It has been regarded by some as an 'essential atrophy;' by others, as a result of disease in certain vaso-motor and 'trophic' nerves; as an effect of persistent irritation acting upon the cervical sympathetic, especially in its upper and middle ganglia; and by others, with much more probability, as a result of irritation acting upon the fifth nerve, or at least upon some of its fibres. This last view is powerfully supported by the fact that, whilst the atrophy is generally limited to the territory of the fifth nerve, in some cases it has even been restricted to one or other of its divisions. Thus, it has been known to be limited to the parts supplied by the two lower divisions of the fifth nerve; whilst Lovell Gulland has described a case of hemiatrophy of the face confined to the area of distribution of the first division of the fifth nerve. Then, again, in some few cases the atrophy has been associated with pain in the corresponding regions of the face, such as might be caused by neuritis.

This last view of the pathology of the affection has been confirmed by Mendel (*Berlin. klin. Wochenschrift*, May 7, 1888), who, at a necropsy on one of these cases, found a proliferative neuritis of the branches of the fifth nerve, especially of the second division, corresponding to the area of the greatest intensity of facial atrophy. With these changes there was also atrophy of the descending nucleus, though other parts of the nucleus and the roots of the fifth were healthy.

The opposite state—that of *unilateral hypertrophy of the face*, also occurs as a very rare event, mostly as a congenital condition. D. W. Montgomery of California has recently recorded (*Med. News*, July 15, 1893) an interesting example in which the deformity commenced in a boy, without apparent cause, at about the tenth year. He gives references also to nine other cases of this peculiar affection.

Treatment of unilateral facial atrophy, as well as of its opposite, has hitherto proved of little or no avail.

H. CHARLTON BASTIAN.

UNILATERAL HYPERIDROSIS. Excessive perspiration on one half of the body occurs more or less habitually, or only after exercise. It may be limited to one side of the face and head, or the neck and arm may be included; or it may implicate the whole of one half of the body. It has sometimes, and especially when limited to the face and neck, seemed to be one of the symptoms due to paralysis of the cervical sympathetic nerve. In other cases no such relation has been ascertained to exist. It has been met with principally in association with various nervous diseases, such as hemicrania, diabetes mellitus, locomotor ataxy, dementia paralytica, and Graves's disease. *See* SYMPATHETIC SYSTEM, Disorders of.

TREATMENT.—In the absence of definite information as to the pathology of this affection, it is not possible to indicate any rational principles of treatment. Empirically some of the remedies used for checking perspiration, such as zinc, belladonna, and quinine, may be tried, in combination with nervine tonics such as arsenic and strychnine. *See* SUDORIPAROUS GLANDS, Disorders of.

H. CHARLTON BASTIAN.

URÆMIA (*οὖρον*, urine; and *αἷμα*, the blood).—SYNON.: Fr. *Urémie*; Ger. *Urämie.*

DEFINITION.—This term is applied to a group of nervous symptoms, which occasionally occur in the course of acute or chronic Bright's disease, as well as in other maladies which prevent the secretion or the discharge of the urine.

ÆTIOLOGY AND PATHOLOGY.—The circumstances in which uræmia arises are pretty well ascertained, but the connexion between these circumstances and the symptoms is still obscure. It occurs when there is interference with the secretion or the discharge of urine. It is thus met with in all the forms of Bright's disease; in cystic, tubercular, and cancerous disease of the kidney; in suppurative nephritis; and in cases of anuria, either of obstructive or of non-obstructive origin. But some of these conditions frequently exist for long periods without uræmia being developed, and it is sometimes developed unexpectedly without apparent alteration of the patient's state. The attack is, however, precipitated frequently by pregnancy and parturition; by indulgence in alcohol; sometimes by the recurrence of the menstrual period; and probably by intercurrent disease. But the occurrence of these conditions does not in all cases suffice to induce it, for many women suffering from Bright's disease pass through pregnancy and labour without manifesting uræmic symptoms, and so with other inducing causes.

Of the exact nature of the uræmic process we are unable to speak at present with certainty. Two sets of explanations have been suggested—namely, the *mechanical* and the *chemical*. Dr. Owen Rees in this country, and Professor Traube in Germany, have been among the chief exponents of the mechanical explanations. The former dwelt upon the wateriness of the brain in many cases of uræmia. The latter suggested processes by which that œdema might arise. Sudden increase of blood-pressure, and sudden increase of the proportion of water in the blood, might, he thought, suffice to account for the condition. Rosenstein and others have lent the weight of their authority to these views. Monck has sought to demonstrate by experiment that cerebral œdema from increased pressure may produce the result; but even if these experiments had been correct, which is doubted by many, it cannot be denied that there are many well-marked cases of uræmia in which there is no encephalic œdema. The observation of Popoff, which refers the changes to accumulation of altered corpuscles within the cerebral capillaries, may prove important, if it should be confirmed by other authorities.

Among the chemical theories, one of the earliest was that which referred the process to retention of urea; but many difficulties arise in connexion with this. The very ingenious theory of Frerichs, which referred the process to decomposition of retained urea by the action of a ferment, must now be held to be disproved, in consequence of evidences discovered, both of a negative and of a positive kind. The evidence at present before us seems to point to the probability of the process being due to retention of some excrementitious material or materials. Feltz and Ritter believed that the potassium salts are the only really toxic constituents of healthy urine, and that their accumulation is the cause of the uræmic symptoms. Bouchard believes that, while the potassium salts and other mineral substances are of some importance, other poisonous substances, such as urea, and certain materials including colouring-matters, are of much greater moment, while ammonia and its compounds occupy also a very minor position. Probably also the animal alkaloids play a very notable part in the production of these symptoms. Substances such as the xanthocreatinin of Gautier belong to this category. Landois has made out by experiments on animals that if creatin or creatinin be applied over the motor areas of the cerebrum, convulsions result; and certain other substances often met with in the urine exert a like influence. Such observations make it probable that the precise causation of the group of symptoms may soon be made out. While it is clear that chemical processes account for many of them, it must not be forgotten that microscopic organic changes are doubtless accountable for some.

SYMPTOMS.—All the functions of the nervous system are occasionally involved in uræmia. Among the disorders of the sensory function the most common are pain, especially in the head, sometimes very intense and persistent; dimness of sight, or actual blindness of one or both eyes, sometimes attended by no change in the retinæ, at others by retinitis albuminurica; ringing in the ears; and sometimes deafness. Among the motor changes, the most striking are the general convulsions or twitching of muscles; the tendency to vomiting; and sometimes extreme dyspnœa. Among cerebral and mental derangements, drowsiness, torpor, coma, and delirium are the chief.

The forms of uræmia generally recognised are the *chronic* and the *acute*.

1. Chronic Uræmia.—This comes on gradually, and may at first scarcely attract attention; the habitual listlessness and indifference of manner observable in cases of Bright's disease becomes increased. Movements are slow, and speech is somewhat indistinct. There is often dimness of sight, ringing in the ears, uneasiness in the head, or violent and persistent headache. The condition of the patient varies; the symptoms occasionally pass away, but they constantly recur, and become by degrees more intense. The drowsiness passes into torpor. If the patient is roused to speak, his articulation is thick and indistinct. It soon becomes impossible to elicit any answer; lethargy deepens into coma; the breathing becomes stertorous, or rather hissing in character, the air being driven against the teeth or hard palate; and death supervenes. Sometimes, instead of silence, a rather noisy delirium comes on, in which wild prolonged howls alternate with muttering, and occasionally with paroxysms of excitement. Sometimes, again, there is a low prolonged muttering, with a repetition of the same expression time after time. Subsultus tendinum and twitching of the facial muscles are commonly seen throughout. Convulsions, vomiting, and diarrhœa are frequent symptoms; epistaxis also occurs, but more rarely. This form of uræmia is a common mode of fatal termination in cases of chronic Bright's disease. It sometimes occurs—but much more rarely—in the early stage of the inflammatory form.

2. **Acute Uræmia.**—This includes all the varieties in which the symptoms are suddenly developed. There are three common forms—the comatose, convulsive, and mixed; and several less common, namely, the delirious, dyspnœtic, ocular, and articular. In the acute *comatose* form, after headache, giddiness, affection of sight, vomiting, or delirious excitement, coma is rapidly developed; or it may supervene without such premonitory symptoms. The face is usually pale; the pupils are dilated or unaltered, and react slowly to light; or, on the other hand, there may be a red spot on the cheek, injected conjunctivæ, and contracted pupils. There is a peculiar stertor—not the deep snoring of hæmorrhagic apoplexy, but a sharper, more hissing sound, produced by the rush of expired air on the hard palate or teeth. The coma may rapidly deepen, and death ensue within a few hours; or, on the other hand, the patient may rally and continue free from the symptoms permanently; or sooner or later uræmia recurs in one or other of its forms, and issues in death. Acute uræmic coma occurs in all of the forms of Bright's disease, but is most frequent in the inflammatory and cirrhotic varieties.

The second acute type is the *convulsive*, which may almost exactly simulate epilepsy; or be unattended by loss of consciousness; or may affect certain groups of muscles, and simulate tetanus. The attack comes on suddenly, with or without warning. It may be single and solitary; or attacks may occur in rapid succession, five or six, or even more, in the course of twelve hours. They may be recovered from; or they may prove rapidly fatal, either during the paroxysm, or in the coma which succeeds it. They occur in all the forms of Bright's disease, but most frequently in the cirrhotic and in the inflammatory varieties. The existence of cirrhosis of the kidney is not infrequently first revealed by the occurrence of convulsions.

The other types of uræmia, namely, the *mixed*, in which sudden coma occurs with convulsions; the *delirious*, in which the ordinary symptoms are replaced by restless delirium; the *dyspnœic*, in which there are sudden and often most distressing attacks of breathlessness, without corresponding change in the physical signs of the lungs or heart; the *tetanic*; the uræmic *blindness*; the *disturbances of hearing*; the *itching* or *burning sensation* in the skin; the *vomiting*; the *diarrhœa*; and the *articular* uræmia, which Jaccoud has described as presenting many features in common with acute rheumatism, need not be particularly described here.

DIAGNOSIS.—There is little difficulty in distinguishing the chronic form of uræmia when fairly established. The most important evidence is, of course, afforded by examination of the urine. Uræmia sometimes resembles fever or meningitis; but the history of the illness, the state of the urine, the temperature, and the mode of breathing, suffice to distinguish it from these conditions.

The acute form of coma may closely resemble cerebral hæmorrhage with loss of consciousness, but differs in the absence of paralysis of one side, and also in the character of the breathing, while the condition of the urine also affords important indications.

The convulsive type may resemble epilepsy, but it has rarely the initial cry, the corpse-like pallor, the predominance of convulsions on one side, the turning in of the thumbs on the palms, and the loss of reflex irritability. The chief reliance is to be placed on the analysis of the urine, because, although after true epilepsy albumen may be present, and urea may perhaps be diminished for a time, the secretion soon returns to its natural condition, while in uræmia it is always distinctly albuminous. From opium-poisoning or belladonna-poisoning it is distinguished by the condition of the pupils, and the examination of the secretion.

PROGNOSIS.—The occurrence of uræmia in a case of Bright's disease is always grave; the chronic form is hopeless, and when it occurs the duration of life cannot be long. The acute forms are often recovered from; they sometimes subside spontaneously, but when they are due to chronic renal disease, death cannot, as a rule, be regarded as far off. When they result from acute disease, they are not so hopeless, because the conditions on which they depend are frequently removed by treatment. Puerperal cases, although involving great immediate danger, are very frequently recovered from, probably because they owe their origin to a combination of circumstances which do not long persist.

TREATMENT.—The first indication is to seek to re-establish the suppressed secretion of the kidneys. For this purpose, dry cupping, wet cupping, leeching, or poulticing over the loins, and the administration of digitalis and other non-irritating diuretics, are indicated. Frequently the blood must be relieved more rapidly than the action of the diuretics can accomplish. Venesection to the amount of eight, ten, or more ounces, may be of use, especially in the puerperal forms, and the acute inflammatory cases. Dilution of the poisoned blood may also be tried, as has been urged by Dr. William Carter in his admirable *Bradshaw Lecture*. Purging with hydragogue cathartics, such as elaterin, or compound powder of jalap, or jalap and scammony; diaphoretics, such as nitrate of pilocarpine subcutaneously or by the mouth; and the hot pack—any of these methods may often relieve the system until there is time for the diuretics to act. Above all, the nitrate of pilocarpine and the hot-air bath are to be recommended. When the convulsions are severe, sedatives, such as bromide of potassium—or still better of sodium—and hydrate of chloral, are useful. Chloroform is of great value. It quiets the nervous system, and checks the convulsions more rapidly than anything else; but the tendency to coma in the individual case must be carefully kept in view during administration. Tonic remedies, and articles of diet such as milk (at once nourishing and powerfully diuretic, and supplying little excrementitious matter), should be given, to ward off a return of the symptoms when the uræmia has disappeared, as well as during its continuance. In puerperal cases an obvious and important indication is to complete the labour with as little delay as possible.

In the related condition of diabetic coma treatment is unavailing; but intravenous injection of saline fluid may be attempted, and general stimulants given. *See* TRANSFUSION OF SALINE FLUIDS.

T. GRAINGER STEWART.

URETERS, Diseases of.—SYNON.: Fr. *Maladies des Uretères*; Ger. *Krankheiten der Harnleiter.* — Morbid conditions of the ureters are so generally parts of, or associated with, diseases of the bladder or kidney, and so naturally come to be described in the articles treating of these several diseases, that a separate account or distinct classification of them is perhaps scarcely called for; and a brief description of the most important will be sufficient for all practical purposes.

1. **Congenital Malformations.** — A double ureter is the most frequent malformation, the division sometimes reaching as far as the bladder. In very rare cases a triple ureter has been found. Congenital malformations leading to more or less complete obstruction of the ureter are found most often near the pelvis of the kidney. If the obstruction is complete, it gives rise to hydronephrosis (*see* HYDRONEPHROSIS). If incomplete, a slighter degree of the same condition results, the pelvis and calyces becoming dilated, and the kidney-substance atrophied and indurated. The chief congenital obstructions are—(1) Total obliteration of the ureter as it leaves the pelvis. (2) Valvular opening from the pelvis into the ureter. This becomes gradually more complete as the dilatation of the pelvis increases. (3) A spiral arrangement of the ureter. (4) An abnormal renal artery pressing on the ureter as it leaves the pelvis. The incomplete obstructions frequently give way at intervals, when there will be a copious flow of urine, usually of low specific gravity and pale colour.

2. **Acquired Obstruction.**—*Complete* obstructions which are not congenital may arise: First, from impaction of a renal calculus; this may take place at any point, the most frequent being at the brim of the pelvis or the vesical orifice. Secondly, from external pressure, as from uterine cancer, pelvic tumours, fibrous bands, enlarged glands, or fæcal accumulations, in which case the condition would at first be incomplete. *Incomplete* obstruction arises most frequently from impediments to the discharge of urine, existing in the prostate or urethra. In the former case, the bladder being in a state of constant over-distension, the valved opening of the ureter is closed with unnatural force. In the latter the hypertrophy of the bladder increases the length of the portion of ureter lying in the bladder-walls, and the bundles of muscular fibres more or less constrict the orifice. Any cause giving rise to hypertrophy of the bladder will therefore tend to obstruct the orifice of the ureter, as is seen in chronic cystitis, stone in the bladder, and other conditions. The opening is still further narrowed by swelling of the mucous membrane, the result of subacute or chronic inflammation. Occasionally the orifice may be partially obliterated by a villous growth in the bladder. *Stricture* of the ureter is found in rare cases, apparently the result of previous inflammation and ulceration. Slight obstruction may occur during pregnancy, from the pressure of the gravid uterus.

3. **Dilatation.**—The part of the ureter above any obstruction is always found more or less dilated, according to the degree and the duration of the impediment. If the condition be acute and complete, little or no hypertrophy of the coats of the ureter will be found; but if chronic and incomplete, its walls will be thickened, both by fibroid change and by hypertrophy of the muscular coat. The dilated ureter is always tortuous, being increased in length as well as in diameter, and may even resemble a portion of small gut. The mucous membrane is always opaque and somewhat thickened, occasionally red and injected, and frequently pigmented from previous attacks of inflammation. A largely dilated ureter may sometimes be felt through the abdominal wall. There will probably be some degree of pain or uneasiness in the course of the canal, or in the loin; and a tendency to sickness.

4. **Inflammation.**—*Simple* inflammation of the ureter is frequently found, as an extension either from the bladder or from the pelvis of the kidney. *Septic* inflammation accompanies septic pyelitis, due to extension of decomposition from the bladder to the pelvis of the kidney (*see* SURGICAL KIDNEY). *Scrofulous* or *tubercular* inflammation

almost invariably accompanies a similar condition of the bladder or kidney.

5. **Malignant Disease.** — Cancer may extend from neighbouring organs into the ureter, but there is no reason to believe it ever primarily takes origin there.

Neither the diagnosis nor the treatment of an affection of the ureter can be separated from that of the disease to which it is secondary. MARCUS BECK.

URETHRA, Diseases of.—SYNON.: Fr. *Maladies de l'Urèthre*; Ger. *Krankheiten der Harnröhre*.—The affections of this canal comprise urethritis with its various consequences, such as gleet, warts, periurethral abscess, inflamed follicles, and stricture; syphilis and soft chancre may also affect the urethra. For descriptions of most of these affections, the reader is referred to the articles GONORRHŒA; GLEET; SYPHILIS; and VENEREAL SORE. Some forms of (1) Urethritis, (2) Neuralgia, (3) Stricture, and (4) Foreign Bodies, remain for consideration here.

1. **Urethritis.**—The origin of urethritis is not exclusively due to inoculation with gonorrhœal pus, a fact of great medico-legal importance. Inflammation of the urethra, usually running a less severe course than the gonorrhœal form, may be set up by leucorrhœal, menstrual, and other discharges from the vagina. Traumatic irritation of the urethra may be excited by the passage of instruments or a calculus, or by the introduction of foreign bodies by the patient; in such cases soreness and scalding attend the first subsequent micturition, and swelling and discharge follow within twenty-four hours.

Asparagus, beer, arsenic, and other substances, have the power of producing urethritis in some persons; highly acid urine and oxaluria may also occasion slight urethral irritation. A very mild form of urethritis is an occasional concomitant of early syphilis; it is, however, always very limited in extent, and subsides spontaneously. In gouty urethritis the inflammation may be as severe as in well-marked gonorrhœa, and attended by the complications met with in that disease, and affecting the testes, bladder, eye, or joints. The leading distinctions of gouty urethritis are the milkiness of the discharge, and the absence or small amount of swelling of the fore part of the urethra; while scalding in the perinæum, and irritability of the bladder are severe and prominent symptoms.

Tubercle sometimes affects the urethral passage; it is always a very indolent affection, being due to the slow degeneration and ulceration of tubercular deposits in the deeper portions of the canal, and usually associated with similar disease in the prostate or bladder. In such cases the irritability and inflammation of the bladder are always more urgent than the urethritis, while the evidence of tubercular disease in other parts of the body is usually sufficient for diagnosis.

2. **Neuralgia. Pain in the Urethra.** The causes of pain felt in the urethra may be found in some diseased condition of the tube; or it may be independent of any local morbid action. Gouty irritation is a frequent cause, and a nervous condition produced by prolonged debauchery of various kinds is not uncommon. The gouty state is relieved by the treatment of the diathesis; the nervous irritation by suitable general treatment, to which may be added local applications which have the effect of dulling the sensibility of the urethra, such as the passage of sounds, and the use of astringent or (in obstinate cases) of caustic injections to the deeper portions of the urethra. In some cases instrumentation of the urethra excites severe pain; this is best avoided by first injecting about thirty minims of a 10 per cent. solution of cocaine. Oxaluria and a highly acid state of the urine may sometimes produce considerable smarting at the time of micturition; the exhibition of alkalis and suitable dietary will usually suffice to relieve this, which is often a source of considerable annoyance to the patient.

3. **Stricture.** — The average distensile capacity of the urethra has a diameter of ten, or a circumference of thirty, millimetres. This measurement varies in different portions, being widest behind the triangular ligament (the anterior layer of the deep perinæal fascia), slightly less in the bulbous portion, and least of all at the meatus. The meatus varies very much in size, between a mere pinhole and a diameter of fourteen or fifteen millimetres, the most common size being a circumference of twenty-five millimetres. In different persons the general distensile capacity of the urethra ranges between twenty and forty millimetres.

Strictures are abrupt abnormal contractions of the urethra at any given point of its course. Such contractions may be either (*a*) of a temporary nature; or (*b*) permanent.

(*a*) *Temporary Contractions. Spasmodic and Inflammatory Strictures.*—Spasmodic strictures are due to temporary contraction of the muscular fibres surrounding the urethra; inflammatory strictures to swelling and congestion of some part of the canal, the condition being usually associated with more or less muscular spasm. These temporary contractions of the urethral passage, being due to transient causes, involve no permanent lesions. Spasm and congestion may, however, occur at the seat of an organic stricture.

Muscular spasm may arise from reflex irritation, especially the existence of inflammatory swelling and congestion; it may also occur in consequence of the passage of instruments along the canal, or of a calculus. Again, the presence of an organic stricture near the meatus will frequently excite reflex spasm of the deep perinæal muscles. Operations about the rectum may produce a similar effect. Inflammatory swelling, causing narrowing of the canal, is not an infrequent complication of gonorrhœa, and often occurs in cases of enlarged prostate.

Treatment.—The treatment of these conditions should be directed to the removal of the cause. Irritation must be avoided, and congestion allayed by saline purgatives, warm baths, and morphine suppositories. If retention of urine be present, a flexible catheter should be passed (No. 5 or 6 English).

(*b*) *Permanent Contraction. Organic Stricture.*—In the great majority of instances organic stricture is the result of long-continued inflammation following gonorrhœa, leading to exudation into the submucous tissue. This exudate subsequently organises into a low form of fibrous cicatricial tissue, the contraction of which leads to the permanent narrowing. A similar result may also follow on injury of the urethra (*traumatic stricture*), and is then more severe, the new tissue being very dense. The cicatrix left by the healing of a urethral chancre may likewise cause stricture. Congenital narrowing of the meatus is common, and congenital strictures are sometimes met with within the second inch from the meatus.

Organic strictures may be situated at any part of the urethra except the prostatic, being numerically most common in the first inch from the meatus. Burckhart asserts that he has met with strictures in the prostatic urethra, but the writers have not seen such a condition.

The tightest and toughest strictures are generally found near the junction of the bulbous and membranous portions of the urethra; that is, about five inches from the meatus. The membranous portion is only affected when there is a large amount of cicatricial tissue spreading backwards from the bulb. The new fibrous tissue is developed in various forms; thus it may be present as a membranous fold stretching across (*bridle stricture*), or occasionally encircling (*annular stricture*) the canal. There may be only one bridle or several.

Superficial scars of healed ulcers and warts may give rise to patches of tough tissue. Indurated areas and fibroid nodules in the submucous tissue, standing forwards on the surface of the canal, cause irregular projections as well as unyielding indurated patches. These twist the course of the canal and impede the passage of bougies. In other cases, instead of being in limited patches, the indurated tissue may extend evenly along the canal for some distance, making it smooth and gristly, and diminishing its calibre.

The indurated new tissue may form only a thin layer of fibres beneath the mucous membrane, or may extend more deeply, infiltrating the whole thickness of the corpus spongiosum, or even extending beyond it into the tissues of the perinæum, rendering them dense and unyielding. The degree of narrowing of the passage depends in great measure upon the age of the stricture, being greater as time goes on; it may be temporarily increased by muscular spasm or inflammatory congestion. The canal never becomes obliterated, as the term ' impermeable stricture ' would seem to imply. Strictures are always permeable to urine, but may not be so to the passage of an instrument. Strictures vary in behaviour: some yield easily to dilatation and slowly recontract; others are rigid, and can be dilated only to a small extent (*indurated strictures*). Lastly, some dilate quickly, but as quickly shrink back to their previous size (*resilient strictures*).

Secondary Effects of Organic Stricture.—The urethra in front of a stricture may be quite healthy, but if the condition has existed for some time the mucous membrane between the meatus and narrowest contraction is often puckered and indurated, or is excoriated or ulcerated. Sometimes just in front of the stricture artificial openings are found; these are the mouths of false passages which have been made by inexpert instrumentation. False passages may, after passing outside the urethra in front of the stricture, run for some distance, ending as *cul-de-sacs*; or they may re-open into the urethra behind the stricture; less often they extend up for some distance between the bladder and rectum, or open into the latter. At the seat of stricture the mucous membrane is often roughened, puckered, and of a dull white opaque colour; behind it the urethra is dilated, pouched, pigmented, and even ulcerated; the mucous membrane may be coated with muco-pus, sometimes mixed with phosphates. The pouches, formed by distension of the follicles, may be the starting-point of perinæal abscess, which may burst into the urethra or on to the surface of the perinæum; or, lastly, may burrow upwards between the bladder and rectum and round the prostate. If a perinæal abscess bursts into the urethra and on to the surface of the perinæum, fistulous tracts are formed, which ultimately become very dense and unyielding. Such fistulæ are often multiple, and may open in various situations. The bladder, ureters, and kidneys will, in neglected cases, show evidence of secondary mischief. The changes induced are partly dependent upon the obstruction to the free flow of urine, and partly inflammatory as the result of decomposition of the retained urine. Thus the bladder-walls hypertrophy in order to overcome the obstruction; but if the compensation is inefficient, dilatation and sacculation will ensue. The ureters dilate, and the walls hypertrophy; the pelvis dilates, and the pyramids of the kidney-substance become flattened, crescentic, and subsequently wasted; the remaining renal substance is stretched and sclerosed, and the condition known as hydronephrosis results. If the urine should decompose, acute cystitis, becoming chronic, will follow, and the micro-organisms will find their way to the ureter and pelvis of the kidney, exciting pyelitis, and in severe cases acute nephritis with numerous points of suppuration—the so-called 'surgical kidney' (*see* Surgical Kidney). These results only occur in cases which have not been treated at all, or only imperfectly.

Symptoms and Diagnosis of Organic Stricture.—The symptoms of organic stricture of the urethra are more evident in the case of an old and narrow stricture. Few symptoms attract observation before the stricture is well advanced. The most common and the earliest is a scanty muco-purulent discharge. This sign is indeed very often the indication of the chronic inflammation of limited areas of the passage which ends in stricture. When the stricture is developed the symptoms are more definite, namely, slight dribbling of urine after micturition has apparently ceased; small size of the stream, which may be forked and twisted; and gradual increasing difficulty, with straining and pain, in micturition, which is more frequent than normal. Any or all of these symptoms may be absent, even when the canal has lost as much as two-thirds of its distensibility. Usually to these troubles are added occasional attacks of complete retention of urine from temporary spasm or congestion. There may also be the signs caused by the various secondary complications.

Examination of the urethra by means of a steel sound or gum-elastic bougie will reveal the number and situation of the strictures present. The distensile capacity of the various parts of the passage can be determined by the urethrameter.

Treatment. — The treatment of organic stricture consists, first, in removing from the habits and diet of the patient all causes of functional disorder.

Temperance in alcoholic drinks, in stimulating or highly seasoned foods, in sexual indulgence, and in some forms of exercise, such as horse and bicycle riding, must be enforced. Due attention to the condition of the skin and bowels, and sufficient bodily exercise, are requisite. Although attention to these matters will not in any way remedy the existing condition of a stricture, yet they will prevent congestion and spasm, and so obviate the temporary and often dangerous aggravation of the sufferings caused by this condition.

Locally the passage must be restored to, and maintained at such calibre as, on the one hand, will enable the bladder to empty itself completely by each act of micturition; and, on the other, will allow a sufficient margin to prevent stoppage of the flow of urine during occasions of temporary swelling or spasm. Such an expansibility would seem for most persons to be about one inch or three-quarters of an inch in circumference—that is, about No. 10 English; though in practice it is advisable to dilate somewhat further (No. 12 English) than this, to allow sufficient margin for neglect on the part of the patient. In all organic strictures there is a tendency to contract again; hence, when sufficient expansibility has been established, it must be maintained by the frequent passage of a bougie. In most cases the patient should be taught to do this for himself.

Various methods, neither of which is applicable to all cases, are employed for dilating the strictured part of the passage. Some methods, such as the use of caustics, or the cautery and forcible dilatation, have fallen into desuetude; those in modern use are (*a*) gradual interrupted dilatation; (*b*) gradual continuous dilatation; (*c*) internal urethrotomy; (*d*) external urethrotomy.

(*a*) *Gradual interrupted dilatation* is attained by passing metal sounds or flexible bougies (preferably the latter) through the stricture. At the first sitting that size which will just pass through the stricture should be used; subsequently larger sizes must be used, until No. 12 or 13 English can be passed. It is probable that in most if not all cases the stricture is partly stretched and partly torn in this method of treatment. The instruments may usually be passed at intervals of two or three days.

(*b*) *Gradual continuous dilatation.*—In this method a flexible catheter is passed through the stricture and tied in. As the stricture yields the instrument must be removed, and a larger one introduced from time to time, lest, being loose, the catheter escape from the urethra. A week or ten days usually suffice to dilate the stricture to the requisite dimensions. The nature of the process appears similar to that of a seton in ordinary sinuses or cellular tissue: the fibrous tissue becomes loose and succulent, and its fibres permeated by leucocytes; superficial ulceration with destruction of the cicatricial tissue also occurs in some cases.

(*c*) *Internal urethrotomy* is accomplished by means of a concealed knife conducted to the stricture by running in a split sound which passes through it into the bladder. As the knife is pushed on it is made to project and divide any resisting tissue met with. A full-sized catheter is then passed, and the bladder emptied. At the end of ten days instrumentation should be commenced in order that the passage may be kept properly dilated.

(*d*) *External urethrotomy.*—When attacked from without, the situation of the stricture is indicated by a staff passed down to or through it. In the former case the cicatrix is divided from before back, and in the latter from behind forwards. Cutting from before back is the more common operation, since if the staff can be passed through the stricture internal urethrotomy can usually be done. If the urethra is laid open in front of the stricture the orifice must be sought for—too frequently a long and tedious process—and the contraction then slit up along a fine director which has been passed into the bladder.

Various instruments have been devised and are employed for carrying out the methods shortly described here; some more suited than others to particular cases.

Comparison of the different methods.—Gradual interrupted dilatation is applicable in a larger number of cases than is any of the other methods described. It is least attended by evil consequences, and is most effectual in strictures of recent formation situate near the bulb. Objections to this method are the rapidity with which recontraction takes place if the passage of bougies be neglected by the patient, and the impossibility in some cases of dilating the stricture beyond a certain calibre without exciting shivering, pain, pyrexia, or even local inflammation and abscess. Epididymitis is sometimes set up by the passage of the instruments. Indurated strictures are sometimes so tough and dense that they cannot be sufficiently dilated.

Gradual continuous dilatation is easy and rapid, but is liable to be followed by speedy recontraction. It is useful in cases in which it is necessary to obtain a rapid dilatation of a very narrow stricture, in consequence of advanced vesical or renal disease. In these the bladder must be given rest without delay, yet the condition of the kidneys is most unfavourable to any operation. If there is great difficulty in passing an instrument into the bladder, it is advisable, when it is passed, to tie it in. The objections to continuous dilatation are that it confines the patient to bed, and in some cases excites local irritation and constitutional fever sufficiently severe to require its abandonment.

Internal urethrotomy is applicable with best results in young patients, in whom renal changes are absent or only slight. It is also preferable for those patients who prove intolerant of interrupted or continuous dilatation, since serious disturbance rarely follows incisions made in strictures between the meatus and the bulb. The locality of stricture has much to do with deciding upon the adoption of internal division. The shallow constrictions, so-called 'bridle strictures,' and the elastic rapidly yielding and as rapidly contracting resilient strictures, are always situate in the penile portion of the urethra, and are specially amenable to incision, while they are very little affected by the passage of bougies.

The great thickness and toughness of certain strictures of the bulb render their division the only mode of securing even moderate duration of their dilatability. The recontraction of a stricture after it has been divided would seem to follow less speedily than after it has been treated by gradual dilatation.

External urethrotomy is needed in comparatively few cases. It is advisable when the perinæum is hardened and beset with fistulæ; or in those still more rare cases in which no instrument can be introduced into the bladder. Under such circumstances it is requisite to attack the stricture from the surface.

4. **Foreign Bodies impacted in the Urethra.**—Foreign bodies of various kinds may be introduced into the urethra, and may lodge in the canal, impeding the free flow of urine, or even arresting it, and eventually exciting inflammation and abscess. Calculi passing from the bladder may lodge behind a stricture, or close to the meatus. Portions of a bougie or catheter may be broken off in attempts to pass a stricture.

The symptoms pointing to the presence of a foreign body are usually pronounced. There is pain, with difficulty in passing water, and perhaps complete retention; while the foreign body can usually be felt in the canal, and can be seen through the endoscopic tube.

Treatment.—The foreign body must be removed by means of appropriate forceps introduced through the largest-sized endoscopic tube which can be passed. If this is found to be impracticable, the urethra must be opened from without.

Berkeley Hill.
Charles Stonham.

URIAGE, in Isère, France.—Thermal muriated sulphur waters. *See* Mineral Waters.

URIC ACID DIATHESIS: URIC ACID CALCULUS.

—Synon.: Lithuria; Lithiasis; Nephrolithiasis; Fr. *Diathèse Urique*: *Calcul Urique*; Ger. *Stein aus Harnsäure*.

Ætiology.—Uric acid is probably the outcome of the metabolism of the proteid tissues of the body. It is allied to urea, and takes its place in the urine of birds and most reptiles. It is not, however, to be considered as a less oxidised antecedent of urea, but as a distinct product of metabolism of nitrogenous material, either of food or of tissue waste. By some physiologists it is considered that the liver is chiefly concerned in the production of uric acid, and this theory is grounded on these facts—that urea is produced in the liver; that urea and uric acid are nearly allied; and that in so-called liver-disorders there is frequently a deposit of uric acid in the urine. On the other hand, the liver contains but the merest trace of uric acid; and the blood in the hepatic vein has no more in it than that in the portal vein. Uric acid is found in decided amount and always in the spleen; and as all the blood from this organ passes through the liver, so the uric acid which escapes from the liver may have come to it from the spleen with the blood-stream. In what relation does the kidney stand to the formation of uric acid? On this point, also, authorities differ. Many hold that the kidney merely picks it out of the blood by the agency of the epithelial cells of the uriniferous tubules; but there is good reason to believe that, whereas the water and saline constituents of the urine are excreted by simple diffusion through the blood-vessels of the glomeruli, and are therefore influenced as to excess or deficiency by greater or less blood-pressure, the urea, uric acid, pigments, and other constituents, are, in part at least, the result of a true secreting power of the renal cells. However formed, uric acid exists in normal urine in combination with bases in the form of quadriurates; this was demonstrated by Bence-Jones, and lately confirmed by Sir William Roberts (*Med.-Chir. Trans.*, vol. lxxiii. p. 245). The uric acid in healthy urine will separate and be deposited after cooling and standing for some time, and this process of spontaneous liberation is favoured or retarded by the various urinary ingredients: thus, the water of the urine leads to the splitting up of the quadriurates and the liberation of uric acid, but the salines and the pigments tend to retard its separation. When these ingredients are present in normal amount no precipitation of uric acid takes place within the urinary passages; if, however, they are deficient from any cause, gravel or calculus may result. The frequency of stone in the children of the poor is thus explained by Sir William Roberts: They are fed chiefly on farinaceous and starchy food, which contains but little mineral matter as compared with milk or meat; consequently the urine is deficient in saline ingredients, and precipitation of uric acid is apt to occur. This poverty of salines in the diet of the rice-eating classes of India may probably explain their proclivity to calculus. On the other hand, the immunity enjoyed by seafaring men may be chiefly due to the full amount of salt which they consume, and which retards the precipitation of free uric acid in the body.

Characters.—Pure uric acid is colourless, but clinically it is always associated with the urinary pigments, which give it the well-known red or brownish-red colour. It is so slightly soluble in water that it is readily precipitated when the amount of urine is scanty; it is dissolved by alkalis, and consequently is never deposited in alkaline urine. Under the microscope, pure uric acid assumes the form of rhombic crystals, stars, bundles, tablets, and prisms. When combined with bases in the form of brick-dust sediment, amorphous granules are seen.

Calculi or concretions composed of pure uric acid vary in size from the finest red sand up to masses of several ounces in weight. They are of a red colour, very dense and hard, indistinctly stratified, usually of a flattened oval shape, of a rough tuberous exterior when single and smooth, and faceted when multiple. To this, however, some exception must be made, for it is not uncommon when only two or three co-exist in the bladder, to find them rough and mammillated, as if there had been no contact or rubbing between them. When the uric acid is combined with other ingredients in a calculus, the colour is paler, the lamination more distinct, and the texture more friable. Pure uric acid calculi, when broken by the lithotrite, form sharp angular fragments; the urate concretions, on the other hand, break more readily and form flaky laminated *débris*.

The quantity of uric acid secreted daily is very small and variable—so small that physiologically it deserves no more notice than kreatin and other organic bodies which are occasionally present in human urine. Its sparing solubility, and its readiness to form deposits in the body as biurate of sodium in gout, and as gravel and calculus in the urinary tract, render it of the greatest importance as a pathological factor. The amount excreted does not appear to depend greatly on the nature of the food taken. The vegetable feeder is as liable to its deposit as one who lives largely on animal food. Alcoholic drinks, taken even in limited quantity, certainly, in very many, are apt to lead to the precipitation of uric acid or urates. The tendency to uric acid gravel and calculus varies greatly in different countries, and in different parts of the same country. In England it prevails much more in the eastern and south-eastern than in the western and north-western districts. Uric acid forms the nucleus of nearly all the calculi in the adult of the eastern counties; but if such a person, having such a stone in his bladder, should become a resident in the west or north-west, the deposit of uric acid will commonly change to one of oxalate of lime; and should he return to the east, the accretion to the stone will again become uric acid. This contrast—which seems so great—is not so in reality, because uric acid is known, under certain reagents, to split up into urea and a compound of oxalic acid.

Symptoms.—The deposit of uric acid or urates, even in large amount, frequently takes place without any disturbance of health. Sometimes, however, it is accompanied by local irritation of the kidneys and bladder, characterised by frequent micturition, with a sense of heat and even pain during the act; and often, too, by flatulence, heartburn, and other signs of indigestion. There is, however, no habit of body, and no recognised symptoms of a definite kind, which are so plainly due to, or so constantly accompanied by, an excess of uric acid, as to warrant the continued use of the term 'uric acid diathesis.' Uric acid and its salts are found in excess in many organic diseases; in maladies of the heart and lungs in which oxidation of the blood is so frequently deficient; in organic diseases of the liver; in pernicious anæmia; in almost all febrile diseases; and sometimes associated with diabetes mellitus, chorea, and certain skin-diseases. They are deficient or absent in advanced disease of the kidney, in general anæmia, and in some exhausting non-febrile diseases. The relation of uric acid and the urates to the gouty state is interesting and important, and has recently been re-investigated by Sir William Roberts (*Med.-Chir. Trans.*, vol. lxxiii. p. 339). *See* Gout.

Treatment.—It will be apparent that the general treatment of uric acid in excess must be comprised in that of the various diseases in connexion with which it occurs. For that condition of indigestion and urinary irritation in which the chief feature is the copious deposit of uric acid and the urates, alkaline remedies, such as bicarbonate of sodium, or the bicarbonate, citrate, and acetate of potassium in twenty or thirty grain doses, dissolved in three or four ounces of water, and given three or four times a day, afford the best and quickest relief; they produce an alkaline condition of the urine, and a complete solution of the deposit for the time. Salts of lithium have a similar effect. Lately, piperazine, a new remedy, has attracted considerable attention; it has a strong alkaline reaction, and a minute quantity added to fresh acid urine will render it alkaline; it does not, however, have this effect on the urine when taken internally. It is unquestionably a powerful solvent of uric acid; it combines with it to form a urate of piperazine, and this urate is far more soluble than the urate of the metallic bases. Its precise value has yet to be ascertained, but there is abundant evidence to show that, when taken to the extent of fifteen to twenty grains daily in aërated water, it has a marked effect in eliminating uric acid by the kidneys, and it is also beneficial in the gouty state. When hepatic congestion and general sluggishness of all the secretions are present, saline aperients combined with alkaline remedies are indicated, such as the mineral waters of Carlsbad, Friedrichshall, Contrexeville, and Vichy, all of which seem to have the power of exciting all the alimentary glands to healthy and increased action. Free libation of hot water alone is of infinite value, and it may be doubted whether the benefit of some of the natural mineral waters just named be not due as much to the amount of water taken as to their saline ingredients. A well chosen, simple diet is above all things important—the avoidance of rich, sweet, or highly seasoned food, and the very sparing use of wine and all alcoholic drinks.

William Cadge.

URINARY CALCULUS.—A calculus formed in any part of the urinary apparatus. *See* Calculus; and Renal Calculus.

URINARY FEVER.—Synon.: Urethral Fever; Catheter Fever.

Definition and Varieties.—The above terms have been applied by different writers to various conditions traceable to mechanical irritation of the urethra. The resulting symptoms vary, according to circumstances, in their nature, mode of onset, severity, and prognosis. At the present time considerable confusion exists on the subject of urinary fever, and this is doubtless partly due to the fact that the ill-effects consequent on instrumentation of the urethra have not been sufficiently differentiated. These injurious consequences may be conveniently grouped as follows:—

1. Shock, slight or severe in nature, appearing immediately after the passage of the instrument, transient in duration, and ending in recovery.
2. An acute febrile attack, occurring some time after instrumentation (usually following the first act of micturition), transient in nature, but of some severity while it lasts, and ending in recovery. *Acute transient urethral fever*; *urinary sepsis.*
3. Acute recurrent attacks, similar in nature to that just mentioned. *Acute recurrent urethral fever*; *recurrent urinary sepsis.*
4. Acute septic infection, with definite pyæmic lesions, and secondary centres of inflammation.
5. An insidious attack, without any well-defined symptoms, but marked by gradual loss of health and strength, often with an ultimately fatal termination.

Ætiology.—Any form of mechanical irritation of the urethra may lead to one of the conditions just mentioned. There is no doubt that unfavourable symptoms are most likely to occur if the disease rendering instrumentation necessary is situated in the membrano-prostatic portion of the urethra. Urinary fever, using the term in its broad signification, may occur alike in those who have been subjected to instrumentation before, and in those on whom a catheter has been passed for the first time. In the case of patients accustomed to catheterism, an attack of urinary fever may be determined by the use of an instrument of larger size than customary. In many cases of the more severe forms of urinary fever there is evidence of disease of the kidneys, but in others these organs are apparently healthy, or the disease is so slight, as shown by *post-mortem* examination, that it seems inadequate *per se* to account for death. It would appear from the researches of Sir Joseph Fayrer that malarial subjects are especially prone to resent instrumentation of the urethra. Some people undoubtedly suffer more than others, this intolerance increasing with advancing years, and with any general derangement of the health.

PATHOLOGY.—Considerable difference of opinion exists as to the nature of urinary fever, and the elucidation of the matter has no doubt been rendered more difficult in consequence of endeavouring to account for most, if not all, of the ill-effects of urethral irritation by the same explanation. Two separate theories have been advanced, and each of them has its advocates and opponents. After carefully considering the facts and opinions on both sides, the writer believes that both these theories are applicable for the rational pathological explanation of the five conditions above mentioned.

1. *Neurotic Theory.*—It is contended by the supporters of this view that urinary fever is directly traceable to reflex congestion and inflammation of the kidneys, resulting from the irritation of the sympathetic and cerebro-spinal nerves of the urethra. That the nervous excitability of the urethra is very great is undoubted, and is fully proved by numerous observations. It has already been stated that irritation of the membrano-prostatic urethra is more likely to be followed by untoward results than is that of the penile portion, and it is worthy of note that it is precisely in this part that the nervous supply is most abundant. That irritation of the nerves of the urethra may produce reflex effects upon the kidneys excites no surprise, when it is remembered that the sympathetic nerves of the urethra are derived from the abdominal sympathetic, and are therefore in direct anatomical continuity with the nerves of the renal plexus. Irritation of the urethral nerves might thus induce extreme congestion of the kidneys, associated with suppression of urine, followed by hæmaturia. If such a condition were excited in kidneys previously healthy it would be transient in nature, and would, under ordinary circumstances, speedily terminate in recovery; on the other hand, if the kidneys were already the seat of some inflammatory mischief, it is by no means improbable that the fresh irritation might cause congestion and inflammation of already damaged organs, checking the function of those parts which are alone able to carry on excretion, and thus destroying the patient by the gradual accumulation in his blood of the obscure antecedent products of urea. In more rapidly fatal cases the access of new inflammatory mischief might determine the occurrence of suppuration in the kidney, the patient succumbing to acute interstitial nephritis with scattered points of suppuration. *See* SURGICAL KIDNEY.

It is perfectly well known that an involuntary shudder often accompanies the end of the act of micturition in healthy men. The state of shock which occasionally follows the introduction of a catheter is no doubt largely explained by this physiological phenomenon. It shows that in some men a nervous system exists so sensitive as to be seriously impressed by even a normal act; much more so, then, by so rude a measure as the passage of a catheter. Irritation of the sympathetic nerves of the urethra might reflexly induce engorgement of the abdominal vessels, and thus induce the temporary faintness and shock not infrequently met with as the result of catheterism.

2. *Septic Theory.*—Although some of the conditions arising from mechanical irritation of the urethra are, and others may be, due to nervous influences, yet in the majority of cases of acute febrile attacks there is little doubt that the ill effects are dependent upon sepsis. Acute septic intoxication and septic infection may occur through a wound in the urethral mucous membrane or in the bladder, as they may do in the case of a wound of any other part. But while this is fully recognised and conceded, it is asserted by some that, irrespective of the undoubtedly septic and infected cases, so-called urinary fever (excluding shock) is dependent upon the absorption of toxic matters from the urine as it passes over the wound made in the urethra by instrumentation. It is highly probable that this view is correct in the majority of cases. Traumatism is a constant accompaniment of acute urinary fever, a few drops of blood following the withdrawal of the instrument. In support of this septic theory it must be borne in mind that the temperature remains normal until *after* the first act of micturition succeeding instrumentation: the urine charged with pyogenic material is thus brought in contact with the wounded surface; the septic matter is absorbed, and the febrile symptoms follow. If the urine be in a healthy condition, and antiseptic precautions be taken, urinary sepsis is much less likely to occur. Mr. Reginald Harrison asserts, moreover, that if a perinæal opening

be first made, and thus *free* drainage be afforded, urethral operations for stricture are not followed by urinary fever.

In most cases of stricture and of enlargement of the prostate with residual urine there is an ample supply of septic material, which, under suitable circumstances, would be readily absorbed. In the recurrent form of urinary fever it is almost certain that each attack of fever occurs in response to the absorption of a fresh dose of poison, for it is difficult to suppose (unless we are prepared to admit that the mere passage of the urine, without absorption, can produce a febrile attack) that the nervous system is responsible for repeated attacks at intervals of time during which no fresh irritant has been applied.

Some cases, perhaps, are of a complex nature, due in part to reflex congestion with inflammation of the kidneys, and in part to some form of septic absorption.

Symptoms, Prognosis, and Treatment of the Various Forms. — (1) *Urethral shock.*—In certain persons, especially those of a neurotic temperament, the passage of an instrument, even when used with the greatest dexterity and gentleness, produces symptoms of more or less severe shock. In the slightest, and fortunately by far the most frequent, cases, the patient, although not experiencing pain, becomes pale, breaks into a profuse cold sweat, feels dizzy, and not infrequently faints. Occasionally the state of insensibility is accompanied by convulsive movements of the whole body. These symptoms are more likely to occur when an instrument is passed for the first time, or if the surgeon uses one of a larger size than that to which the patient has been accustomed. Recovery ensues in a few moments, and the patient experiences no further ill-effects. Fresh air, the recumbent position, and a dose of sal volatile is the only *treatment* necessary at the time; but the patient should be directed to keep quiet for the remainder of the day.

In rare cases this condition of shock is very much more serious, and may terminate fatally within twenty-four hours. In such there is total suppression of urine; and *post mortem* the kidneys are found to be intensely congested, although they are often otherwise healthy; it is probable that the fatal termination is due to cessation of the excretion of urea. *Treatment* is of little avail. Free purging by croton oil or elaterin, hot stupes to the loins, warm diluent drinks, the hypodermic injection of pilocarpine, and the warm vapour bath offer the best chances of success.

(2) *Acute transient urinary fever. Acute urinary sepsis.*—The symptoms characterising this condition come on soon after the first act of micturition following instrumentation. In most cases it will have been noticed that there was perhaps some slight resistance to the onward passage of the instrument—resistance, it may be, so slight that moderate pressure easily overcame it; on withdrawing the instrument a drop or two of blood was observed to follow it, indicating the infliction of a wound.

No symptoms occur immediately, but after micturition the patient is seized with a severe rigor, and experiences pain in the loins and back, often severe in nature. The temperature rises, and may reach 105°; the pulse is accelerated; headache and nausea are fairly constant; and vomiting and diarrhœa are occasional accompaniments of the condition. The urine is diminished in quantity and may be bloody. The cold stage is quickly succeeded by profuse sweating, and a feeling of great heat. The temperature falls, the pains diminish and ultimately disappear, the urine loses its bloody tint and is secreted in larger quantity, and the patient quickly recovers and experiences no ill after-effects.

Such an attack lasts usually from twenty-four to thirty-six hours. No doubt it may attack alike those whose kidneys are known to be diseased, and those in whom these organs are apparently healthy. In some cases the patient may remain febrile for a longer period than above stated—a matter for anxiety, as it may indicate the supervention of acute nephritis. Subsequent instrumental attempts may induce other attacks, but by no means necessarily. That this form of urinary fever is of septic origin there can be little doubt, and for its prevention the surgeon should endeavour to avoid injury to the urethra, and should adopt antiseptic precautions. Those who believe in the neurotic origin of this form of fever advise the administration of quinine and opium for some days before any instrumentation is resorted to, but this treatment is of little or no value.

The *treatment* of the patient during the attack is conducted on ordinary principles. During the cold stage the patient should be wrapped in blankets, and hot bottles applied; hot drinks may be freely taken, but alcohol should be avoided. The sweating stage hardly calls for treatment; it is in itself a sign of recovery. The bowels should be opened by croton oil placed on the back of the tongue, and hot fomentations may be applied to the loins if there be much pain. Complete rest for some days is advisable, and all irritation of the urethra must be avoided.

(3) *Recurrent urinary sepsis.*—In some cases recurrent febrile attacks similar to that just described may occur at intervals of two or three days, quite independently of any fresh urethral irritation. During the interval between successive attacks the patient is apparently quite well. Such cases appear to be analogous to chronic septic intoxication as met with in wounds elsewhere. The *treatment* is conducted on the same lines as above indicated; the bowels should be kept open

freely, and diuretics with diaphoretics may be useful. In malarial subjects quinine may prove beneficial.

(4) *Acute septic infection and pyæmia* may occur after instrumentation with wound of the urethra as in wounds elsewhere. Secondary centres of inflammation in the viscera and distant parts, suppuration of the joints, with repeated rigors, high temperature, and the usual symptoms attendant on infective processes, serve to distinguish the case from one of acute urinary sepsis.

(5) *Persistent urinary fever.*—In some instances, especially in cases of enlarged prostate with residual urine necessitating the daily employment of the catheter, the patient falls into a general state of ill-health, insidious in its onset and progress, and sometimes ending fatally.

In such cases it will be found that there is old-standing disease of the kidneys. The irritation of the urethra appears to light up fresh mischief—mischief in many cases added to by the concomitant absorption of septic material. In the cases of enlarged prostate with residual urine, there is unfortunately in many cases an ample source of septicity in the decomposing urine present in the bladder.

The symptoms may date from the first passing of the catheter. There is very rarely any decided rigor, and the symptoms, unless distinctly septicæmic in nature, may be at first indefinite. The patient complains of general malaise, loss of appetite, and perhaps a feeling of chilliness. Fever may be entirely absent, and is never very marked. The urine is not diminished in quantity as a rule, nor is there any noticeable alteration in the excretion of urea. Perhaps the symptoms of this condition are best explained by the statement often made by the patient himself—'he is not the same man that he was before using the catheter,' and yet he is unable to state definitely from what he suffers.

In the later stages of a fatal case the condition of languor so commonly met with becomes more marked, the patient becomes drowsy and apathetic, and may wander a little at night. Sometimes there may be temporary improvement, only to be followed by a relapse. Death may occur in from six weeks to as many months. Fortunately many cases after some few weeks gradually recover.

In all cases in which the surgeon deems it necessary to employ the habitual use of the catheter, it is most important that every care should be taken to avoid urinary fever. The patient should be confined to his room, which should be kept at an equable temperature; the bowels should be regulated, and the action of the skin and kidneys promoted; the diet should be light, nutritious, and non-stimulating. If the amount of residual urine is considerable, it should on no account be all drawn off at once, but the bladder must be gradually emptied in the course of a few days. Attention to these fundamental points will do much to ward off serious effects. Should they, however, in spite of all precautions, manifest themselves, the patient must be kept quiet in an equable temperature, instrumentation must be carried out as carefully and seldom as is consistent with the exigencies of the case, and the general excretory system requires attention. If rest is broken, opium or some other form of narcotic must be given; but the use of opium requires prudence and supervision in view of the renal imperfection. Stimulants are frequently necessary. C. Stonham.

URINARY ORGANS, Diseases of. Synon.: Fr. *Maladies des Voies Urinaires*; Ger. *Krankheiten des Harnapparates.*

In accordance with the plan adopted in other corresponding articles, it is intended here merely to discuss briefly the diseases of the urinary organs from a general point of view. These organs include: (1) The kidneys, with their infundibula and pelves. (2) The ureters. (3) The bladder. (4) The urethra. The particular diseases of each part of the urinary apparatus will be found treated of under these several headings, and in certain special articles, to which the reader is referred.

Summary of Diseases.—The primary division of diseases into *functional* and *organic* must be recognised in connexion with the urinary organs.

I. **Functional.**—The following disorders may be included under this group: (1) The excretory function of the kidneys is influenced and often disturbed by various conditions, physiological or pathological, quite independent of any obvious local morbid change. Hence the urine is modified in different ways and degrees, as regards its quantity or quality. This may depend, for instance, upon some general condition, such as fever or gout; upon causes originating in the nervous system; upon digestive disorders; or upon special diseases, such as diabetes. (2) The muscular structures in certain parts of the urinary apparatus are liable to be affected, and this applies practically to the bladder and urethra. The bladder is subject to undue irritability, spasm, or paralysis, the last being especially important in connexion with disease of the spinal cord. The urethra is not uncommonly the seat of spasm, giving rise to more or less spasmodic stricture, and consequent retention of urine. (3) It is believed by some authorities that the kidneys or bladder may be affected with neuralgic pains, there being no local mischief to account for them.

II. **Organic.**—The numerous affections of the urinary apparatus belonging to this division may be thus classified:—

(1) *Injuries* of different kinds, under which would be included not only those of traumatic origin, but also ruptures or perforations due to disease.

(2) Conditions affecting the *circulation*, namely, (*a*) Acute or chronic congestion. (*b*) Embolism. (*c*) Hæmorrhage. The first two are only met with in the kidneys, but hæmorrhage may occur from any part of the urinary apparatus.

(3) *Acute Inflammatory Diseases.*—These are of different kinds, and comprise the following subdivisions: (*a*) Acute Bright's disease, involving the kidney-substance. (*b*) Suppurative inflammation of the kidney, usually terminating in renal abscess. (*c*) Inflammation of the lining mucous membrane. The urinary mucous tract may be involved throughout, but usually only a limited portion is affected, and thus we have the different complaints known as *pyelitis*, or inflammation of the pelvis of the kidney; inflammation of the ureter, rarely existing alone; *cystitis*, or inflammation of the bladder; and *urethritis*, or inflammation of the urethra, the common form of which is gonorrhœa. This mucous inflammation often leads to a purulent discharge, and may terminate in ulceration or gangrene. (*d*) Inflammation around the kidney—*perinephritis*; or around the bladder—*pericystitis.*

(4) *Chronic Inflammatory Diseases.*—These may remain after the acute forms, or they are chronic from the outset. Practically they include only certain forms of Bright's disease; chronic abscesses; and mucous inflammations.

(5) *Malpositions and Malformations.*—These abnormal conditions may be of considerable importance in connexion with the urinary organs, being either congenital or acquired, and varying in their nature. 'Movable kidney' is a form of displacement always to be borne in mind, especially in females. *See* KIDNEYS, Diseases of: 25. Malpositions of.

(6) *Hypertrophy and Atrophy.*—The morbid changes of this kind belong to two main classes, according as they affect the kidney-substance, or the walls of the duct or bladder. Atrophy of the kidney is either acute or chronic, the latter being in almost all cases a form of chronic Bright's disease, but it may be congenital or due to compression.

(7) *Obstruction, Dilatation, and Accumulations.*—Obstruction may be due to different causes, and localised at either of the orifices, or at any point in the course of the ureter or urethra. As a consequence of such obstruction, and occasionally from other causes, dilatation occurs, affecting either the pelvis and infundibula of the kidney, the ureter, the bladder, or the urethra, according to its seat; the entire tract may be thus implicated. Accumulations also follow, either of urine, pus, or other materials, and these may become very serious. Hydronephrosis and pyonephrosis are well-known forms of disease, in which urine or pus, or a mixture of both, thus accumulates in the pelvis of the kidney. Retention of urine in the bladder is of common occurrence, arising from various causes. Cystic disease of the kidney may be mentioned under this head, as in some instances, at any rate, it probably arises from limited dilatations of the renal tubules.

(8) *New-Growths and Degenerations.*–Cancer may involve any or every part of the urinary apparatus. Non-malignant growths are met with in exceptional cases. Tubercular disease is an important and serious malady in connexion with the urinary organs. The kidneys are liable to albuminoid disease, and to fatty degeneration. Syphilitic growths may also be found in them.

(9) *Gravel, Calculi, and Foreign Bodies.* The formation of gravel, and of calculi of different kinds, with the morbid conditions resulting therefrom, are of peculiar importance in relation to the urinary organs, and a large proportion of cases in actual practice belong to this group. It may also be mentioned here that foreign bodies are sometimes found in the bladder or urethra, introduced from without either intentionally or accidentally.

(10) *Parasites.*—Certain parasites are particularly associated with the urinary organs, especially the Bilharzia hæmatobia. Hydatid-disease is met with in rare instances. The filaria sanguinis hominis is probably related to chyluria; and bacteria occasionally occur in the bladder. *See* CHYLURIA; and ENTOZOA.

ÆTIOLOGY AND PATHOLOGY.—It would be quite out of place here to attempt to discuss the ætiology and pathology of some of the morbid conditions that have been mentioned, such as urinary calculus, or cystic disease of the kidney, which are fully considered in special articles. All that can be done is to point out in a general way the principal morbific causes which act upon the urinary organs, and the modes in which their diseases originate. (1) These organs are much more liable to injury than most others. This may not only come directly from without, but may also be inflicted by articles introduced into the urethra or bladder, by surgical operations, or by calculi. (2) Certain morbid conditions are congenital, being the result of imperfect development, or of intra-uterine disease. (3) Exposure to cold or wet undoubtedly originates serious renal disease in some cases—for instance, acute Bright's disease; and it is also supposed to give rise in other instances to less serious complaints in connexion with the urinary organs, such as congestion, or some form of mucous inflammation. This cause probably acts by interfering with the cutaneous excretion, and inducing internal congestion. It may also be remarked that want of cleanliness and other conditions of the skin may help in developing renal disease. (4) Affections of the urinary organs are of frequent occurrence in connexion with certain acute febrile diseases, either as essential parts of these diseases, or as complications or sequelæ. Scarlatina and pyæmia demand special mention in this connexion. (5) Abnormal conditions of the urine when first excreted, or the presence of certain materials in the kidney which this organ cannot properly get rid of, are prolific causes of urinary affections. These abnormal conditions and materials may originate in a variety of remote causes, and they are well exemplified by the effects of certain medicines, alcohol, excessive acidity of the urine, diabetic urine, and gout. Such causes may induce congestion, inflammation, chronic renal changes, or calculi. (6) The urinary organs may be implicated as part of some general or constitutional disease, as in cancer, tuberculosis, or albuminoid disease. (7) Certain parasites specially lodge in these organs, as has been already mentioned. (8) The urinary apparatus may be affected as a consequence of some neighbouring disease. For instance, a tumour may compress the ureter or bladder, or obstruct the renal vein; or different structures may be involved by extension. (9) Cardiac diseases which impede the venous circulation, not only cause venous congestion of the renal organs, but in time give rise to serious organic changes. (10) The cause of urinary disease may be in the nervous system. Thus may arise a form of acute congestion of the kidneys; and the paralysis of the bladder, which spinal disease so often produces, is liable to be followed by cystitis and its consequences. (11) One specific disease is associated with the urethra, namely, gonorrhœa; and its effects often extend to the bladder, or even higher up along the urinary tract. Syphilis may also originate its own specific lesions in connexion with the urinary apparatus. (12) It is important to notice that the different parts of this apparatus have an intimate relation to each other from an ætiological point of view. For instance, undoubtedly one kidney may become hypertrophied, if the other should be destroyed by disease. Or a morbid condition may extend directly from one part of the urinary organs to another. Again, urine which undergoes certain changes after its formation is liable to cause mischief. Other relations which probably exist between the different portions of the urinary apparatus are discussed elsewhere. *See* SURGICAL KIDNEY; and URINARY FEVER.

CLINICAL INVESTIGATION AND SIGNS.—Without entering into details, the symptoms and signs which may be associated with urinary diseases can be summarised in the following way, and this summary will indicate the course to be adopted in their investigation. (1) Painful sensations, with or without tenderness, may be referred to the region of the kidneys, perhaps to the ureter, to the bladder, or to the urethra, when these are respectively the seat of mischief. Moreover, disease in one part may be accompanied with sympathetic or referred sensations in some other part; or in certain conditions there may be pain along the spermatic cord to the testis, with retraction of this organ. Other sensations are complained of in many instances, such as itching or tickling at the end of the penis, heat or burning along the urethra, heaviness and weight in the lumbar region, or fulness of the bladder. These feelings are often modified by various causes. (2) The sensations connected with micturition are of special significance, such as a frequent inclination to pass water, a sudden and urgent desire, or strangury. (3) The act of micturition itself is often affected. It may be too frequent or infrequent; difficult, even to complete retention—*dysuria*; irritable, there being a difficulty in retaining the urine; or the urine escapes involuntarily — *incontinence.* The stream of urine is altered in size or shape in some conditions (*see* MICTURITION, Disorders of). (4) The urine itself affords signs of great importance in relation to diseases of the urinary apparatus, in regard to its quantity, physical characters, chemical composition, and microscopic appearances. Indeed, it very often happens that the urine alone affords any reliable clinical evidence of urinary disease. At the same time it must, of course, be borne in mind that this excretion is modified by many other conditions, the urinary organs being quite healthy. This subject is fully treated of elsewhere (*see* URINE, Morbid Conditions of). (5) Urinary diseases often produce important effects upon the blood or general system, as well as upon other organs. Hence arise renal dropsy; the phenomena of uræmia, septicæmia, or the typhoid condition in some forms of disease; collapse sometimes; and morbid conditions affecting the heart and vessels, or certain structures in the eye. These morbid changes may be evidenced by more or less marked symptoms. Moreover, enlargement of the kidney may affect neighbouring structures. (6) Physical examination is of essential value in the investigation of many urinary affections, and in carrying this out the aid of a skilful surgeon is often of the first consequence. The local examination is directed to the determination and investigation of displacements, enlargements, or tumours of the kidneys; conditions of the bladder, especially retention of urine, and the presence of calculi or growths; and morbid states affecting the urethra, such as enlarged prostate, stricture, or the lodgment of a calculus. Physical examination also reveals the changes in other structures already alluded to.

These are the main points which can be usefully discussed from a general point of view with reference to urinary diseases. For their diagnosis, prognosis, and treatment, as well as for more complete details on the various matters alluded to, reference must be made to the different appropriate articles, especially to those which deal with the affections of the several parts of the urinary apparatus. *See* BLADDER, Diseases of; BRIGHT'S DISEASE; KIDNEYS, Diseases of; RENAL CALCULUS; SURGICAL KIDNEY; URETERS, Diseases of; URINARY FEVER; URINE, Morbid Conditions of, &c.

FREDERICK T. ROBERTS.

URINE, Incontinence of.—The involuntary discharge of urine from the bladder, the patient being either unable to retain it, or unaware of its escape. *See* MICTURITION, Disorders of; and SPINAL CORD, Diseases of.

URINE, Morbid Conditions of.—SYNON.: Fr. *Etats Morbides de l'Urine*; Ger. *Pathologische Harnveränderungen.*

INTRODUCTION.—The urine is the excretion by which the products of nitrogenous waste are eliminated from the body. Alterations in its characters give valuable information regarding tissue-change in the body, and may indicate the presence of disease which would otherwise remain undetected. They therefore require detailed attention. Before entering, however, upon the discussion of the morbid conditions of the urine, it will be well to describe briefly its characters and mode of secretion in health.

In reptiles and birds the waste nitrogenous products of the body are excreted as uric acid and urates; and the urine is solid. In amphibia and mammals they are chiefly excreted as urea, and the urine is liquid. In man a certain amount of uric acid is always present, though very small in proportion to that of urea, the ratio in health being about 1 to 33. It occurs either free or in combination as urates.

Human urine is a clear liquid, of a yellow colour, acid reaction, peculiar odour, and saline taste. It consists essentially of a watery solution of urea, extractive and colouring matters, and salts. Its average specific gravity is about 1,020, but this varies according to the proportion of solids it contains.

Secretion of Urine.—Until lately, the theory of Ludwig regarding the secretion of urine was the prevalent one. He believed it to be a process of filtration of water and salts from the vessels in the glomeruli, and that these were partly reabsorbed in the tubules by the cells lining them. But it has been shown by Heidenhain that the cells of the tubules also play an active part in excreting, inasmuch as sulphate of indigo injected into the blood does not colour the glomeruli, but colours the cells of the tubules. The original theory of Bowman has thus been revived, and the process of secretion of urine may be looked upon as consisting of two parts—first, the filtration of water, and probably of a small quantity of salts, which takes place under pressure from the vessels of the glomeruli; and secondly, the excretion of urea and other solid constituents by the epithelial lining of the tubules. The water which exudes from the glomeruli dissolves and removes the substances excreted by the tubules, and is very possibly also to some extent reabsorbed in its passage. The greater the difference is between the tension of the blood in the glomeruli and that of the fluid in the tubules, the more rapid is the secretion of urine. But it is not the mere rise in blood-pressure which increases the rapidity of urinary secretion. It is really the increased rapidity of the flow of blood through the renal vessels which is the true cause; and if the pressure of blood in the veins be high, as in cases of mitral regurgitation, the flow of blood will be slow and the secretion scanty, although the pressure be high in the arteries. The conditions for a free secretion of urine thus are—(*a*) a quick flow of blood through the renal vessels, and (*b*) slight resistance in the urinary tubules and passages. The secretion may therefore be increased either by raising the pressure in the renal arteries, or by diminishing that in the tubules and veins; and, *vice versâ*, it may be diminished by lessening the blood-pressure in the glomeruli, or by raising the pressure of blood in the renal veins or of the urine in the tubules. The blood-pressure may be raised either generally throughout the body, or locally by dilatation of the renal arteries. These arteries have considerable power of contraction, so much so that they can lessen the pressure in the glomeruli even when it is raised throughout the body generally. The blood-pressure may be raised in the body generally by the contraction of the arterioles from exposure to cold, by mental excitement, by the influence of food, or by the action of certain drugs, such as digitalis. It may be lowered by shock, by exposure to external warmth, or by rise of the bodily temperature, as in fever. It seems probable, from experiments made by the writer and Mr. Power, that the arterial tension in the glomeruli may be locally diminished, even when the general blood-pressure is increased, by the action of digitalis, which, while causing contraction of the vessels generally, affects those of the kidney more especially, and thus, by their contraction, lessens the blood-supply to these organs. The vessels of the kidney are controlled by the medulla oblongata; and when this is stimulated, either directly by a galvanic current or by asphyxial blood, or reflexly by irritation of a sensory nerve, the renal vessels contract. Dr. Roy has shown that they are also very sensitive to slight changes in the chemical constitution of the blood, water or urea causing slight contraction, followed by greater and longer dilatation. Digitalis does so also; but the contraction is much longer. Common salt, nitrate of sodium, and acetate of potassium cause dilatation without previous contraction. They act upon the vessels even when the nerves are cut, and therefore they must affect them either directly, or through some local vaso-motor nervous apparatus.

By experiments on the kidneys of amphibia, which have a separate vascular supply to the glomeruli and tubules, Nussbaum has found that sugar, peptones, and albumin are excreted through the glomeruli; but that urea is passed out through the epithelium of the tubules, and in passing out causes increased secretion of water from them.

Characters of Urine. — 1. **Transparency.** — Healthy urine is clear when passed, but after standing some time a light flocculent precipitate falls. This consists of mucus and epithelial cells from the urinary passages. A hummocky, white, and sharply defined upper surface indicates the presence of crystals of oxalate of calcium in the cloud. Small white flocculi of this size and shape, looking somewhat like small worms, may occur suspended in the freshly passed urine of persons who have suffered from gonorrhœa or prostatitis some time previously. On microscopic examination they are found to consist of aggregations of leucocytes. The writer has found the presence of these flocculi useful in diagnosing gonorrhœal rheumatism where no history of gonorrhœa was given by the patient.

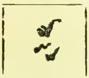

Fig. 176.

Urine which is clear when passed may afterwards deposit sediments of urates or phosphates. These are distinguished from each other by warming the urine. The urates dissolve and the urine becomes clear; but the phosphates are not dissolved, and the urine is rendered more turbid by the heat. On the addition of a few drops of acid the phosphates dissolve readily, and the urine becomes clear. When the urine is concentrated and contains a large quantity of urates, it may become turbid almost immediately from their deposition, if it is passed into a cold vessel.

Turbidity of the urine as it is passed is generally, however, due to earthy phosphates, mucus, pus, or blood. The whitish or light colour of the turbidity due to the first three causes distinguishes it from turbidity due to blood. The addition of a few drops of acetic acid causes the turbidity due to phosphates to disappear, while it does not remove that due to mucus or pus. Turbidity due to pus is distinguished from that due to mucus by the presence of albumin. The albumin may be recognised by adding a drop or two of a clear solution of ferrocyanide of potassium to the urine previously acidulated by acetic acid. If the turbidity is not increased it is due to mucus. If it is increased it may be due to pus, or to mucus in albuminous urine. In this case, let the urine stand until the sediment has deposited, pour off the supernatant liquid, add a small piece of caustic potash to the sediment, and stir it for some minutes with a glass rod. If it is due to pus it will become more transparent and tough, forming a thick mucilaginous fluid which flows with difficulty when the quantity of pus is small. When there is much pus it will form a thick, glassy, coherent lump. If due to mucus it will not become thick and coherent. If due to blood the addition of a drop of simple tincture of guaiacum and twenty drops or more of ozonic ether will give a blue colour.

2. **Colour.**—The colour of urine varies from an almost imperceptible yellow to a dark brown or almost a black. Four degrees are usually distinguished—*pale*, *normal*, *high-coloured*, and *dark*. It is usually understood that the description applies to urine seen in a white chamber-pot, from one-third to one-half filled, or more exactly, as suggested by Vogel, in a cylindrical glass about three and a-half or four inches in diameter. *Pale* urines are those which under such circumstances vary from an almost complete absence of colour, so that they are indistinguishable from water, except when seen in thick layers, up to a straw-yellow colour. *Normal* urines are those which have a golden yellow up to an orange-yellow colour. *High-coloured* have a reddish-yellow to a red colour; and *dark* urines have a deep red-brown or blackish colour.

These variations in the colour of urine are to a great extent due to the proportion of water in which the urinary pigments are dissolved. Watery urine is pale, and concentrated urine is high-coloured. It is probable that they also depend on variations in the nature of the pigments chiefly present. Sometimes they are due to an admixture of foreign colouring-matter, such as bile or blood, or to substances taken internally and excreted in the urine, such as rhubarb.

Clinical Import.—Pale urine occurs when secretion is rapid, and the urine is consequently dilute, as after copious draughts of liquid, or exposure to cold. It is found also in cases of granular kidney, anæmia, chlorosis, diabetes mellitus and insipidus, and after hysterical fits, asthma, or other forms of nervous excitement.

High-coloured urine occurs when the secretion is diminished by profuse perspiration; and also in disorders of the liver, and febrile conditions, or from lessened circulation through the kidney in cardiac disease. The colour of the urine is generally deeper after food, and the urine may be high-coloured after a large meal in healthy persons.

In cases of albuminuria the urine is generally pale when the disease is of renal origin; high-coloured when it is of cardiac origin.

Dark urine generally owes its colour to bile, hæmoglobin or blood. Bile gives it various tints of brown or green; hæmoglobin or blood imparts a smoky, blood-red, or coffee colour. When blood is mixed with much pus in a strongly alkaline urine, the colour may be greenish-brown. Rhubarb gives a reddish colour to alkaline urine. This colour disappears on acidulating. The writer has known compound rhubarb powder render the urine so red as to lead to the belief that the patient was suffering from hæmaturia, the magnesia having rendered the urine alkaline, and thus brought out the red colour of the rhubarb. This is at once distinguished by adding acetic acid, when the colour of the rhubarb disappears. Carbolic acid or creasote extensively used, either externally or internally, renders the urine blackish or black. In cases of melanotic cancer the urine, although of a normal colour when voided, may become black after standing; and this darkening is much accelerated by the addition of nitric acid or other oxidising agents.

3. **Quantity.**—The quantity of urine passed in twenty-four hours varies very greatly. The average may be roughly stated to be about fifty ounces, and the ordinary variation is about one-fifth of the quantity above or below the normal. The quantity is usually increased by anything which raises, and lessened by anything which diminishes, the arterial tension. Thus, cold and nervous excitement will increase it, while warmth and quiet usually diminish it. The quantity passed during the waking hours is much greater than during the hours of sleep; and the fact that a person has to rise during the night one or more times to pass water awakens suspicion of renal disease, or of excessive secretion.

According to Dr. Haig, excess of uric acid in the blood and urine lessens secretion, while diminution of this acid increases the urinary flow. The quantity is lessened by acute inflammation of the kidney; by weakness of the circulation—as in cases of feeble heart or mitral disease; by febrile conditions; and by removal of water from the blood through other channels, as by copious purgation or diarrhœa, profuse perspiration, or the occurrence of œdema or effusion into serous cavities.

Although temporary conditions may cause the amount of urine passed in one day to differ much from that of another, yet in healthy people it usually equalises itself in two or three days, unless there be constant disturbing influences, such as persistent cold.

Clinical Import.—(*a*) A persistent *increase* in the quantity of urine may indicate diabetes mellitus, polyuria, waxy kidney, or granular kidney. These are diagnosed by the presence of sugar in diabetes; by the entire absence of both sugar and albumin in polyuria; by the presence of considerable albumin in waxy kidney; and by the presence of albumin (though only in small quantity), and of high arterial tension, in granular kidney. The conditions in which temporary increase in the quantity of urine occurs are exposure to cold, nervous excitement, hysterical fits, copious drinking, the use of diuretic medicines or articles of food containing tartrates or citrates, and the consumption of certain forms of wine and alcohol, as hock and gin.

(*b*) A quantity of urine *below the average* may be due to habit, leading the individual to drink little fluid; or to habitual exposure to heat, leading to excessive perspiration. A diminution in quantity also occurs in acute inflammation of the renal glomeruli or tubules; in subacute exacerbations of chronic inflammatory conditions; in weakness of the circulation; and in certain disordered states of the nervous system. It also occurs in cases of granular kidney approaching a fatal termination, and is then a sign of grave import.

4. **Specific Gravity.** — This is most easily ascertained by the form of areometer which is called a *urinometer*. In using this instrument care should be taken that it is clean and dry before it is put into the urine, and that it does not touch the sides of the vessel. The surface of the fluid forms a meniscus, and the graduation on the stem of the instrument should be read off at the lower edge of the meniscus with the eye on a level with it. When there is not sufficient urine to take the specific gravity, it should be diluted with one, two, or as many times as may be necessary, volumes of water, and the specific gravity taken. The decimal figures of the specific gravity thus found are then multiplied by the number of times the urine has been diluted, in order to get the true specific gravity. Thus, if the urine has been diluted by adding four times its own volume of water to it, its bulk is increased to five times that of the original urine. If the specific gravity of the diluted urine is 1002, the specific gravity of the original urine is $1{\cdot}000 + ({\cdot}002 \times 5) = 1{\cdot}010$. The urinometers give the specific gravity at 60° F.; and at any temperatures above this they indicate a lower specific gravity, and at temperatures below a higher specific gravity, than the true one.

The specific gravity of the urine depends on the proportion of solid matters which it holds in solution. The amount of water in the urine fluctuates much more than the solids, and therefore the specific gravity varies also. It is less when the urine is watery, and greater when it is concentrated. The average specific gravity is about 1020, but it may vary in health between 1010 and 1025, or even beyond these limits. In some persons the writer has seen it as high as 1038 without either sugar or albumin being present. Such high specific gravity is met with most frequently either in persons of a gouty habit who drink little water, or in women who abstain from liquid in order to diminish the frequency of micturition under circumstances where it might be inconvenient to evacuate the bladder. It varies in the same person at different times of the day, and in different portions of urine passed at the same time. As the urine is secreted and accumulates gradually in the bladder, it becomes arranged in layers according to its specific gravity, the heaviest layers being lowest. If the person remains quiet, so as not to mix the layers, and passes the urine in successive portions into different glasses, their specific gravity may be found to differ.

The specific gravity is diminished during fasting, but is increased after meals, on account of the greater excretion of solids which then occurs. It is diminished when the secretion is quickened, or rendered more abundant and watery by drinking copiously of fluids, by exposure to cold, by mental excitement, or by the use of diuretics. It is increased when the urine is concentrated by abstinence from fluids; by profuse perspiration, which carries off much water by the skin; and by long retention in the bladder, which allows some of the water to be reabsorbed. The variations in specific gravity due to the causes just mentioned are transitory, and are generally succeeded by variations in an opposite direction; so that the specific gravity of the entire urine passed during twenty-four hours may be little altered.

Clinical Import.—A persistently high specific gravity generally indicates diabetes mellitus, or azoturia. It also occurs at the beginning of acute febrile diseases; and in acute nephritis with hæmaturia.

The specific gravity is increased by the presence of albumin alone, as well as by blood. It is sometimes thought that the mere presence of albumin diminishes the specific gravity of the urine, but this is an error. It is quite true that in certain cases of albuminuria the specific gravity is diminished, but this is due to the absence of other ingredients, and not to the presence of albumin. The writer has found experimentally that the addition of serum-albumin to the urine increases its specific gravity.

An abnormally low specific gravity, if persistent, may indicate contracted or amyloid kidney, diabetes insipidus, or hysteria, but a very low specific gravity may occur temporarily from mental agitation, such as from consulting a doctor, or from exposure to cold, such as occurs from going out on a cold morning, especially if it be damp at the same time, or if it occur after previous warm weather.

5. **Reaction.** — Fresh normal urine is generally acid, but when passed after a meal it may be neutral or even alkaline, and sometimes, though rarely, the mixed urine of twenty-four hours may present a similar reaction. Sometimes the reaction is amphoteric or amphogenous, that is, red litmus paper is rendered blue, and blue litmus paper is turned red. The acidity of the urine is chiefly due to acid phosphates, and in part also to free organic acids, such as lactic and hippuric. The amphoteric reaction is probably due to the presence of basic and acid phosphates together. The acidity is less when acid is being secreted by the stomach or skin during digestion or profuse perspiration. It is diminished by vegetable diet, and by alkalis or their salts with vegetable acids. It is diminished in anæmia and chlorosis; and in melancholia or paralysis the reaction may be neutral or alkaline from potassium or sodium carbonates. It is increased by a flesh or a milk diet, by muscular exercise, by drinking, and by acids; and also in fever and diabetes mellitus.

When urine is passed with proper precautions into a vessel which has been previously heated so as to destroy all germs, it may be kept unchanged for years.

Usually it becomes altered quickly, its reaction becoming, first, more strongly acid, then less acid, and finally alkaline. These changes are due to fermentation, which leads first to the formation of acid phosphates, and of lactic and acetic acids, from the extractive matters of the urine, with deposition of uric acid. This increase of acidity is not constant, and deposition of uric acid may occur simply from chemical reaction between urates and acid phosphates. After a varying period the urea becomes decomposed, and carbonate of ammonium is formed, which gives to the urine an ammoniacal odour and alkaline reaction, and causes the precipitation of urate of ammonium, ammonio-magnesium phosphate, calcium phosphate, and calcium carbonate.

The acid fermentation, when present, is probably due to an organism similar to yeast. The alkaline fermentation is probably caused in great measure by bacteria, but it may be induced also by a non-organised ferment, which has been isolated from ammoniacal urine. This ferment appears to be generally produced by bacteria, but it may be produced also, under certain circumstances, by the mucus-corpuscles and epithelial cells in the bladder. Fresh urine inoculated with bacteria from decomposing urine undergoes very rapid change, and the same is the case with the urine inside the bladder when it is inoculated by means of dirty catheters. But similar changes may occur in the bladder in cases of cystitis, even when no instruments have been introduced, and the ferment in these cases appears to be formed by the mucus or epithelium. In order to distinguish whether the alkalinity of the urine depends on ammonia or on fixed alkalis, the red litmus paper must be dried after being dipped in it. If the alkalinity is due to ammonia the blueness of the paper which it produced will disappear, and the paper return to its original red colour; but the blue will remain if the alkalinity is due to fixed alkalis.

SOLID CONSTITUENTS.—The solid constituents of the urine are the ashes of the body, and their quantity varies with the amount of food consumed, and the amount of waste in the tissues of the body itself. Their quality depends on the nature of the nutritive processes and of the tissue-change going on in the body; and it thus forms a useful indication of the healthy or diseased nature of the tissue-change and nutritive processes. Some solids are constantly present, although in varying quantities, in healthy urine; others are only occasionally present; and others again never occur in health, so that their presence is a sign of disease. Those present in health are (1) *nitrogenous substances*—urea, uric acid, allantoin, oxaluric acid, xanthin, kreatinin, sulphocyanic acid, Baumstark's body, and perhaps guanin; (2) *ferments* — pepsin, nephrozymose or ptyalin, and trypsin; (3) *salts*—chiefly chlorides, sulphates, and phosphates of sodium, potassium, ammonium, calcium, and magnesium, sodium chloride being the most abundant; (4) *acids*—oxalic, lactic, and glycerophosphoric acids, possibly present in combination, or partly free; sulphuric acid in two forms—simply combined with bases as sulphates, or united with other substances so as to form ether-sulphuric acids of phenol, kresol, pyrocatechin, indoxyl, skatoxyl, &c.; and (5) *pigments*, and pigment-yielding bodies or chromogens.

Abnormal constituents include albumins, albumoses, peptones, blood, hæmoglobin, methæmoglobin, bile-pigments, bile-acids, grape and milk sugar, leucin and tyrosin, lecithin, cystin, fat, and other substances.

The *quantity* of solid constituents is determined exactly by weighing the dried residue of a given quantity of urine. It may also be ascertained approximately by multiplying the last two figures of the specific gravity by 2·33. This gives the amount per thousand, and from this the total quantity is reckoned. Thus, if a man passes 1,560 c.c. of urine daily, which when mixed has a specific gravity of 1,022, then 22 × 2·33 = 51·26; and 1000 : 1560 : : 51·26 : 79·96 grammes of solids *per diem*.

The most important constituents must now be described.

1. **Urea** (CON_2H_4).—This is by far the largest and most important of the organic constituents of urine, as 70 or 80 per cent. of the entire nitrogen excreted appears as urea. The quantity of urea passed *per diem* by a healthy man is on an average 33·18 grammes or 512·4 grains. Urea may be regarded as the ash of the nitrogenous substances, whether food or tissues, which have undergone combustion in the body, and therefore its quantity fluctuates greatly according to the amount of nitrogenous food consumed, and also according to the rapidity of tissue-change. The variations due to the food are so great, however, that unless the amount of nitrogen in the food consumed be kept rigidly the same from day to day, or food be altogether withheld, they mask the variations due to tissue-change. Hence most of the earlier experiments on the influence of drugs, exercise, &c., on tissue-change, as determined from the excretion of urea, are untrustworthy.

The quantity of urea varies with age, sex, country, and other circumstances; but most of these variations are easily accounted for by the proportion of nitrogenous food taken by children and adults, men and women, English, French, or Germans respectively. Muscular exercise up to a certain point does not increase it, but when excessive it appears to do so; the explanation probably being that in ordinary exercise no destruction of the nitrogenous constituents of the muscle occurs, the energy being supplied by their non-nitrogenous elements, but that when the exercise is too severe and prolonged the albuminous constituents of the muscles themselves become partially destroyed.

Nitrogenous food, such as meat of all sorts, eggs, and gelatin, or substances which yield it, increase the excretion of urea in proportion to the quantity of this sort of food taken. There seems to be a limit, however, beyond which the excretory powers of the kidney will not go; and when this limit is reached, nature saves the organism by diarrhœa, which carries off the excess of nitrogenous food. The addition of fat alone to an abundant diet of meat rather increases the excretion of urea; but when farinaceous food is added to such a diet, the urea is rather diminished. Farinaceous food and fats given to an animal deprived altogether of nitrogenous food, cause it to excrete less urea than if it were totally deprived of food. The addition of farinaceous food and fat therefore appears to lessen the destruction of the nitrogenous tissues themselves.

When much water is drunk, the absolute amount of urea excreted in twenty-four hours is considerably increased, although, the urine being so much more abundant, the percentage of urea is lessened. The increase in urea is said to be greater when the water is drunk during the meal than when it is drunk after digestion has taken place.

Table and other salts increase the quantity of urea, even when no more water is drunk, and also increase the quantity of water, probably by causing part of the water to be eliminated through the kidneys which would otherwise have passed off through the lungs or skin.

Moderate warmth appears to diminish the excretion of urea, probably by increasing the secretion of sweat; but when an animal is kept for a length of time at a high temperature, a condition of fever appears, and the excretion of urea is greatly increased.

Quantitative Estimation.—Formerly urea was usually estimated by Liebig's method of titration with nitrate of mercury; but the mode now usually adopted, as being at once accurate and easy, is the hypobromite process. This method is due to Dr. E. W. Davy, who used hypochlorite of sodium, and this was afterwards modified by Hüfner, who introduced the hypobromite in place of hypochlorite. It depends on the fact that urea, in contact with alkaline hypochlorites (Davy's method) or hypobromites (Hüfner's method) is decomposed, and gives off nitrogen, from the amount of which the quantity of urea decomposed can be readily estimated. Various modifications in the method of applying the process have been introduced, one in common use being that of Russell and West, which consists of a tube in which the urine is allowed to mix with a hypobromite solution, and a pneumatic trough, with a measuring tube, in which to collect the evolved gas. The measuring tube is graduated to give the percentage of urea. Another apparatus is that of Dupré, in which the urine and hypobromite solution are mixed in a bottle connected with the measuring tube by an india-rubber tube. Both of these are well adapted for clinical use. In each of them 5 c.c. of urine is mixed with four or five times its bulk of the hypobromite solution. This solution is prepared by dissolving 100 parts of caustic soda in 250 of water, and adding, when cold, 25 parts of bromine. The solution does not keep, and is best made by having the soda solution of a proper strength, and adding the required quantity of bromine at each analysis.

The readiness with which crystals of nitrate of urea form on the addition of nitric acid to a solution containing it, affords a means of estimating roughly the quantity of urea present in urine. These crystals do not form in normal urine on the simple addition of nitric acid, but do so in urine containing great excess of urea. Thus, if equal parts of strong nitric acid and such urine—say, half a drachm of each—be mixed in a test-tube, and this be placed in cold water, the crystals will soon make their appearance. Another form of test is easily applied on an object-glass. One end of a small piece of thread is put into a drop of urine on the glass; the drop, and the half of the thread, are then protected by a thin covering-glass; and the other end of the thread is moistened with nitric acid. The whole is then put under the microscope, and hexagonal plates of nitrate of urea are seen forming at each side of the thread when there is great excess of urea. If the urine contains the normal, or less than the normal, amount of urea, it must be more or less evaporated by gently heating over a spirit-lamp before the crystals form; and from the extent to which this is necessary a rough estimate of the deficiency of urea may be formed.

Clinical Import.—When the proportion of urea is much above 2 per cent. it generally indicates that the patient is either feverish, or has been perspiring profusely, or that the quantity of water he drinks is too small to ensure the ready elimination of the products of nitrogenous waste. In such cases, if the thermometer does not indicate the presence of fever, or if the patient has not been perspiring profusely, he should be advised to drink more water, in order to prevent the possible occurrence of rheumatic or gouty affections. A small percentage of urea is of much graver significance. It may be due to copious drinking, exposure to cold, or to mental excitement; but when it occurs independently of these causes in elderly persons, it very commonly indicates the presence of contracting kidney.

The name *azoturia* has been given to a condition in which the excretion of urea is excessive, in proportion to the weight of the body. In some persons excessive excretion of urea is associated with increased secretion of water, so that the proportion of urea remains normal. In others the water is not increased, and therefore the urea excreted is not only increased in absolute quantity *per diem*, but its proportion in the urine is greater than normal, so that such urine at once gives crystals of nitrate of urea on the addition of nitric acid. Excessive excretion of urea, both absolute and relative to the amount of urine, may occur for a time in perfectly healthy persons, without any abnormal symptom whatever. In others, however, such an excess of urea is associated with gastro-intestinal derangement and nervous symptoms, the patient complaining of acidity and flatulence, but not of thirst or excessive appetite. There is languor, fatigue after slight exertion, bodily or mental, nervousness, restlessness at night, dull pain in the back, and sometimes irritation at the neck of the bladder, with constant desire to pass water. It is probable that in some individuals the nitrogenous tissue-change goes on more rapidly than in others, and that they consequently require a larger proportion of nitrogenous constituents in their food, to enable them to do the same amount of work; and that when indigestion occurs in such persons, the nitrogenous products of imperfect digestion or tissue-waste, acting as nervous and muscular poisons, lead to the symptoms of which they complain. In diabetes mellitus there is increased excretion of urea, from the greater amount of food taken by the patients; and it has been supposed by Prout that cases of azoturia might pass into diabetes mellitus. *See* LIVER, Functional Disorders of.

The *treatment* consists in ordering nutritious diet, with a large proportion of farinaceous constituents; moderate exercise; avoidance of fatigue, mental or bodily; purgatives; alteratives; and opium.

2. **Uric Acid** ($C_5H_4N_4O_3$).—When pure, uric acid forms white crystals, very sparingly soluble in water. It does not exist free in the healthy urine, but is combined with potassium, sodium, and ammonium. From these it may be separated by the addition of an acid, or by acid fermentation in the urine after it has been passed, as already described.

The absolute quantity of uric acid in healthy urine varies considerably, like that of urea, according to the diet and other circumstances, but its proportion to the urea is tolerably constant—in health being usually about 1 to 33.

As deposited from the urine, uric acid is nearly always coloured. It may be deposited in scattered brown specks, or as a dense deposit of red sand, resembling red pepper in appearance; or it may form a thin film on the surface of the urine. The crystalline character of the deposit can generally, though not always, be recognised by the naked eye. On microscopic examination the crystals usually present a somewhat lozenge-shaped form. This form is modified by rounding and by aggregation. When the angles are rounded off, spindle-shaped, ovoid, and barrel-shaped forms are produced. Sometimes they are elongated, so as to produce a rod; and the aggregation of the lozenge, ovoid, and rod-like forms produces stars and spikes, varying considerably in appearance. Sometimes, also, they appear like dumb-bells (*see* MICROSCOPE IN MEDICINE). The crystals of uric acid are distinguished by their reddish or brown colour, as well as by their peculiar appearance. They dissolve readily in caustic soda or potash, and separate again on the addition of hydrochloric acid. The chemical test for uric acid is generally known by the name of the murexide test. It distinguishes uric acid and urates from other urinary sediments, but it will not distinguish free uric acid from uric acid in combination. The mode of applying it is to warm the sediment in a porcelain capsule, with a few drops of nitric acid and a little water, and to evaporate it carefully, almost to dryness. It is then moistened by a glass rod with diluted ammonia, when a fine purple red colour appears, which, on the addition of a drop of caustic potash, passes into a purplish blue.

Quantitative Estimation.—Uric acid is estimated quantitatively by mixing the urine with one-twentieth of its bulk of hydrochloric acid, and setting it aside in a cool place for twenty-four hours. The deposit of uric acid is then collected on a filter, washed with the least possible quantity of water, dried, and weighed; the weight of the filter having been previously ascertained. As the weighing is troublesome and difficult, the quantity of uric acid may be ascertained by carefully washing it off the filter, and boiling it with peroxide of lead in a little water, so as to convert it into carbolic and oxalic acids, allantoin, and urea. The amount of nitrogen in this solution is then estimated by the hypobromite method already described. Uric acid contains one-third of its weight of nitrogen, so that by multiplying the weight of nitrogen evolved by 3, one obtains the quantity of uric acid. Besides this, ·0045 gramme is to be added for each 100 c.c. of the urine employed.

A method much in use now is Haycraft's. It depends on the fact that in the presence of neutral salts or of an ammoniacal solution of a magnesian salt, uric acid is almost completely precipitated by an ammoniacal solution of silver as an insoluble double salt. The insoluble precipitate is collected on a filter, dissolved in dilute nitric acid, and titrated with a solution of sulphocyanide of potassium (Haycraft, *Brit. Med. Journ.* Dec. 12, 1885). When boiled with solution of potash and cupric sulphate, uric acid reduces the latter to cuprous oxide. The writer has seen a case in which the reduction was so great as to lead the patient, who was a medical man, to think that he was suffering from diabetes mellitus, and to put himself on an animal diet, by which his condition was of course made worse. Such cases can be easily diagnosed from diabetes mellitus by boiling the urine with liquor potassæ, when it will become brown if sugar is present, but not if uric acid alone is present.

2*a*. **Urates.**—Uric acid occurs in combination with potassium, sodium, ammonium, and calcium; the urate of sodium being the most common. The urates, being readily soluble at the temperature of the body, are only deposited on cooling; so that the urine, which was clear when passed, becomes muddy, and a sediment forms, which is commonly coloured like brick-dust, varying in shade, being sometimes almost white and sometimes red. Pale white urates are readily distinguished from phosphates by quickly clearing up when the urine is warmed, while the phosphates do not. Microscopically, the urates of sodium and calcium are usually amorphous; but sometimes the urate of sodium forms globules with projecting spikes, which have caused them to be compared to hedgehogs. The urate of ammonium forms opaque globules, or slender dumb-bells, which are either single or aggregated, so as to form a cross or rosette.

Clinical Import.—Deposit of urates occurs readily after any violent exertion or perspiration, or after errors in eating or drinking. People are often frightened by such deposits, but they are of no importance unless they should persist for a length of time. Persistent deposits occur in febrile conditions or deep-seated organic disease. In cirrhosis the urine is sometimes heavily loaded. *See* URIC ACID DIATHESIS: Uric Acid Calculus.

3. **Oxalate of Lime.**—Oxalate of lime is recognised by the white, hummocky appearance of the top of the mucous cloud in the urine. On microscopical examination, octahedral crystals are seen, presenting the appearance of a folded envelope. It also occurs in colourless dumb-bells. It is distinguished from uric acid by being colourless, and insoluble in alkalis; and from phosphates by being insoluble in acetic acid.

Clinical Import.—The occasional occurrence of oxalates is of slight importance, and is usually connected with diet. In hospital practice the writer has noticed that when the patients ate cabbage for dinner, a large proportion of them had oxalates in the urine next morning. Persistent presence of oxalates in the urine has been supposed to be connected with a peculiar diathesis (the oxalic acid diathesis), the symptoms of which are languor, depression, and melancholia. It is most probable that both this and the presence of oxalates in the urine are simply due to imperfect digestion, more especially as they often disappear readily on treatment by nitrohydrochloric acid. *See* OXALIC ACID DIATHESIS: Oxalate of Lime Calculus.

4. **Phosphates.**—Two kinds of phosphates are found in the urine—phosphate of calcium, and ammonio-magnesium or triple phosphate. They are always deposited when the urine becomes alkaline through fermentation; and when feebly acid urine is heated, so that the carbonic acid is driven off, phosphates are precipitated in the form of a cloud, which might be mistaken for albumin, but clears up at once on the addition of a drop of acid. Under the microscope, phosphate of calcium is amorphous. The ammonio-magnesium phosphate occurs in rhombic prisms, which are distinguished from oxalate of lime by dissolving readily in acetic acid.

Quantitative Estimation.—A rough quantitative estimation of phosphates is made by rendering some urine alkaline with ammonia, and adding an ammonio-magnesium solution to it. A precipitate of ammonio-magnesium phosphate at once occurs if the amount in the urine be normal, but is delayed when the quantity is below normal.

Clinical Import.—In persons having little exercise and a good deal of brain-work, the urine may be turbid when passed, from phosphates present in it, especially during the period of gastric digestion, when much acid has been secreted into the stomach, and the urine is neutral or faintly alkaline. This usually passes away when they get more exercise. It may continue for months, and is of importance only in so far as it renders the patient liable to phosphatic calculus. Such deposits do not indicate increased quantity of phosphates in the urine, but are simply due to diminished acidity. The writer has found the actual quantity of phosphates present in such turbid urines less than in specimens of clear urine from the same individual. Such deposits frequently occur in cases of dilated stomach, where the acid secreted into the stomach during digestion is not reabsorbed. The occurrence of stellar crystals of phosphate of lime in quantity in the urine is, according to Sir William Roberts, of grave import, indicating serious disease of some kind or other, although a few such crystals may occur in normal urine. The triple phosphate almost invariably occurs in ammoniacal urine, and generally appears after urine, alkaline from any cause, has stood for some time. *See* PHOSPHATURIA.

The quantity of phosphates is increased in febrile disorders, and in diseases of the nerve-centres and bones; it is diminished in Bright's disease, and sometimes in dyspepsia, as well as after the disappearance of febrile conditions.

5. **Sulphates.**—Sulphur appears in the urine, (1) as sulphuric acid, combined with inorganic bases to form sulphates; (2) in conjunction with organic radicals, forming ethereal sulphates; (3) as oxidisable sulphur compounds, for example, taurine; and (4) as sulphur compounds oxidisable with difficulty. Amongst the most important sulphur compounds in the urine are indican (indoxyl-sulphuric acid) and skatoxyl-sulphuric acid (*see* Section 7). The presence of sulphuric acid in simple combination with bases is tested by adding barium chloride and hydrochloric acid or excess of acetic acid to the urine, when a white precipitate takes place. The ethereal sulphuric acids are not precipitated at once by this method, but give a precipitate with barium chloride after they have been decomposed by boiling with a mineral acid.

Quantitative Estimation.—Sulphuric acid is estimated quantitatively by means of barium or strontium, but for the details of the process the reader is referred to text-books. The oxidisable sulphur is estimated by boiling with nitric acid and chlorate of potassium, and then determining the quantity of sulphuric acid present, and deducting from the amount thus found the quantity obtained by the first method. The sulphur oxidisable with difficulty is determined by evaporating a measured quantity of urine to dryness, calcining with nitrate of potassium, estimating the sulphuric acid, and deducting from these the quantity found by the second method.

To ascertain the relative proportions of sulphates and ethereal sulphates, acidulate 10 c.c. of the urine with acetic acid, precipitate with 20 c.c. of a 10 per cent. solution of barium chloride, and filter. The precipitate contains the sulphates, the filtrate the ethereal sulphates with excess of barium. Boil the filtrate with strong hydrochloric acid to decompose the ethereal sulphates, and the bulk of the precipitate which then falls will indicate the quantity of them present. The relative proportion of ordinary sulphates and of ethereal sulphates is important. In healthy urine the former are more abundant, but in abnormal conditions the latter. Many substances of the aromatic series are excreted in combination with sulphuric acid, such as phenol, indol, and skatol. When phenol is given internally or absorbed from the skin, it is excreted in combination with sulphuric acid; and as long as abundant sulphates are found in the urine no danger is to be apprehended; but whenever the ordinary sulphates become nearly absent, while the ethereal compound with phenol is abundant, there is danger of poisoning, and the use of carbolic acid should be stopped, and sulphate of sodium or of magnesium freely administered. For the clinical import of indican, *see* Section 7.

Clinical Import.—The excretion of sulphur in the urine may be used as a means of diagnosing the condition of the secretion of bile. The more sulphur is excreted in the bile, the less appears in the urine, and *vice versâ.* In biliary colic, due to impediment to the flow of bile through the ducts, the easily oxidisable sulphur has been found by Lepine to be diminished, but the difficultly oxidisable to be increased.

6. **Chlorides.**—Chlorine is present in the urine in combination with ammonium, fixed alkalis, or alkaline earths. The quantity depends chiefly on the amount of salt taken in the food. When this is constant the excretion is also tolerably constant; but if a larger quantity of salt be then regularly taken, the excess may not begin to be excreted until after about three days, when it will again remain constant; and the excretion will be in excess for about three days after the quantity taken has been diminished. The body has, therefore, the power of retaining a quantity of chlorine. In acute inflammatory diseases the chlorides are retained completely, so as to disappear from the urine. The usual test for a chloride is the curdy white precipitate given on the addition of nitrate of silver to urine acidulated with nitric acid.

7. **Pigments.**—These have not yet been fully examined, but they appear to exist in the urine both in the state of pigments and pigment-yielding substances or chromogens. The pigment of normal urine is urobilin, which, according to MacMunn, is an amorphous yellow-brown pigment. It gives in solution a spectroscopic band at F, disappearing with excess of ammonia or potash, and being again brought into view by acid. When febro-urobilin is present, caustic soda or potash causes the band at F to disappear, and to be replaced by a band nearer the red end of the spectrum. *See* SPECTROSCOPE IN MEDICINE.

Normal urobilin appears to be identical with choletelin, the body produced by oxidising acid hæmatin. Normal urine also appears to contain two chromogens, namely, the chromogen of febro-urobilin, and indican. By the addition of oxidising agents to the urine, or by long standing, febro-urobilin may be produced from the chromogen.

The quantity of indican present in normal urine is small. It is tested by mixing the urine with its own bulk of hydrochloric acid, and adding a drop or two of dilute nitric acid or of a solution of chlorinated lime, avoiding excess, which will bleach the colour. The indican is thus split up, yielding indigo, which colours the urine blue, and may be removed by shaking with chloroform and allowing it to settle. The supernatant liquid remains of a reddish or purplish colour, from the presence, probably, of indigo-red. There appears to be some difference in the indigo-yielding substance, because occasionally the addition of nitric acid to the urine has no effect, although indican be present, as shown by the test thus given; while on other occasions the writer has found the mere addition of nitric acid render the urine a dark greenish-blue, or almost black, from the immediate separation of indigo, which could be removed by the treatment with chloroform just described.

Clinical Import.—Indican appears to be derived from indol, formed by albuminous putrefaction, either in the intestines or in serous cavities such as the pleura. Indol administered subcutaneously increases the indigo in the urine. The indigo is much increased by partial or complete obstruction of the small intestines. It is less affected by affections of the large intestines. It has also been found increased in tabes mesenterica, phthisis, cancer of the stomach, lymphatic growths, cancer of the liver, Addison's disease, and cholera. It is present in large quantity in the urine of persons resident in the tropics. It appears to be increased by turpentine, oil of bitter almonds, and nux vomica. Its presence in excess usually indicates the advisability of administering a mercurial and a saline, in order to clear the decomposing albuminous substances out of the intestine, and the subsequent use of intestinal disinfectants.

A chromogen, yielding a purple colour on the addition of nitric acid, is often met with in cases of anæmia where the urine itself is of a very pale colour, but on the addition of nitric acid becomes almost cherry-red.

8. **Albumin.**—The ordinary form of albumin in urine is serum-albumin. Besides this, we have paraglobulin, fibrinogen, propeptone, and peptone. For the tests of these substances, *see* ALBUMIN; ALBUMINURIA; and ALBUMOSES; and for their clinical import, *see* ALBUMOSURIA; BRIGHT'S DISEASE; and KIDNEYS, Diseases of.

Albuminuria is much more common than is usually supposed, and has been found in America to occur in 11 per cent. of apparently healthy persons presenting themselves for assurance. According to the writer's experience, it is by no means so common in this country. Its significance in such persons has not been completely ascertained, but it has been found that in many such cases, when they are kept under observation, the health goes on deteriorating. Intermittent albuminuria is not infrequent in persons who have been exposed to malaria; and Sir Richard Quain has observed that a similar condition in youth is frequently associated with masturbation. In contracting kidney the albumin is usually small in quantity, and may also be completely intermittent, traces of it appearing only in the urine passed after meals, and being entirely absent from urine passed in the morning. This, as the writer has seen, may occur even when the patient is in a very precarious condition, and is already suffering from nephritic asthma. The late Dr. Mahomed believed that albuminuria may be quite absent in granular disease. Egg-albumin and propeptones readily pass through the kidneys (*see* ALBUMINURIA). It has, however, been found by Stokvis that, if egg-albumin is made to pass through the kidneys for a length of time, the kidneys themselves undergo structural change, glomerular nephritis being induced. These observations confirm the idea, founded on clinical observation by Sir George Johnson, that albuminuria with structural kidney-change may be secondary to continued indigestion.

Quantitative Estimation of Albumin.—The most convenient method is Esbach's. It consists in filling a tube graduated for the purpose up to a mark U with urine, and up to a mark R with a reagent. This is allowed to stand till next day, when the precipitate has settled, and the number opposite the line to which it reaches in the tube gives the proportion of albumin in 1,000 parts of urine. The reagent is composed of 20 parts citric acid, 10 of picric acid, made up to 1,000 parts with water.

9. **Sugar, Acetone, and Aceto-acetic Acid.**—For the tests and indications of these substances, *see* DIABETES MELLITUS.

10. **Inosite, or Muscle-sugar.**—This occasionally occurs in urine alternately with dextrose. It has no action on polarised light; it does not ferment with yeast; and it does not reduce cupric hydrate, although it causes it to dissolve. It is detected by precipitating the urine first with neutral lead acetate, then with basic acetate, collecting the second precipitate on a filter, suspending it in a little water, and decomposing by hydric sulphide, filtering, and evaporating to a small bulk. A drop is then mixed with nitric acid, and evaporated almost to dryness on platinum foil. A drop of ammonia and one of calcium chloride are next added, and the whole gently evaporated to dryness. A rose-red tinge indicates the presence of inosite.

11. **Blood, Hæmoglobin, Methæmoglobin.**—For the tests and indications of these, *see* HÆMATURIA; HÆMOGLOBINURIA; and HÆMOGLOBIN.

12. **Bile-acids.**—*See* JAUNDICE.

13. **Leucin, Tyrosin.**—*See* LEUCIN; LIVER, Atrophy of; PHOSPHORUS, Poisoning by; and TYROSIN.

14. **Cystin.**—*See* CALCULI.

15. **Abnormal Pigments.**—The chief of these are uroerythrin, giving a red colour to febrile urine, febro-urobilin, and urohæmatin. The nature and relations both of the normal and abnormal urinary pigments and chromogens are not yet fully understood (*see* ANÆMIA, PERNICIOUS). For bile-pigments, *see* JAUNDICE.

Melanin.—This black pigment has been found in the fresh urine of patients with melanotic cancer. It appears in the fresh urine as a chromogen, the urine, when freshly passed, being normal in colour; but after standing, or after the addition of oxidising substances, such as nitric acid, the black pigment melanin is formed. This must not be confounded with the dark colour from carbolic acid, or with the dark colour due to great excess of indigo already described.

Accidental Pigments.—Chrysophanic acid may occur from taking rhubarb or senna. The urine containing it becomes red when it is rendered alkaline by caustic alkali. The colour disappears on the addition of acid.

Santonin colours acid urine yellow or greenish. It is distinguished from biliary pigments by becoming cherry-red and purple on the addition of caustic alkali, this colour disappearing on the addition of acid.

The pigments of bilberries, logwood, beetroot, indigo, and gamboge also pass to a certain extent into the urine, and the *Cytisus alpinus* gives it a grass-green colour. After the use, either external or internal, of carbolic acid, creasote, or phenol, the urine may be greenish-brown or almost black. This is due to products of the oxidation of these substances, chiefly hydrochinon. Sometimes the presence of iodide or bromide of potassium in the urine may render it very dark after the addition of nitric acid, on account of the liberation of free iodine or bromine. These are distinguished by their penetrating odours, and may be separated by treating the urine with chloroform and then gently evaporating.

16. **Diamines.**—These do not occur in normal urine, but many of them having a poisonous action, occur in the urine in disease.

17. **Alkaloids.**—These may be precipitated by acidulating the urine with acetic acid, and then adding a solution of iodide of mercury in iodide of potassium. This reagent precipitates albumin, mucin, and uric acid also, but the precipitate with alkaloids is distinguished from that given by the other three bodies just mentioned by being soluble in warm alcohol.

18. **Drugs.**—Salicylates, salol, betol, all give a purple colour when perchloride of iron is added to urine containing them. Phenazone gives a purple-red, and so does thallin, but the colour with the former lasts two or three days, while with the latter it only lasts a few hours before turning to brown. Phenacetin, when taken in large doses, gives at once with perchloride of iron a brown-red, gradually changing to black. Acetanilide is detected by adding a quarter its bulk of strong hydrochloric acid to urine, and boiling for a few minutes so as to decompose the para-amido-phenol-sulphuric acid, as which it is excreted (*see* Section 5). After cooling, a small quantity of a 3 per cent. solution of carbolic acid and a drop of a dilute solution of chromic acid are added. The occurrence of a red colour, becoming blue on alkalising with ammonia, indicates acetanilide.

T. LAUDER BRUNTON.

URINE, Retention of.—A morbid condition in which there is difficulty or inability to expel the urine from the bladder. *See* MICTURITION, Disorders of.

URINE, Suppression of.—SYNON.: Fr. *Suppression de l'Urine*; Ger. *Harnverhaltung*.—Suppression of the secretion of urine arises under two conditions: first, where there is obstruction in the line of outflow; secondly, where there is some fault in the action of the kidney itself.

1. **Obstructive Suppression.**—This is most commonly a result of impaction of a calculus in the ureter of a patient who has already, from some cause, had one kidney permanently destroyed; or of the presence of a tumour, as of the bladder or uterus, implicating both ureters. A little urine is commonly passed during the progress of such cases. It is generally pale, and of low specific gravity. When suppression is absolute, seven or eight days may elapse before the patient appears to suffer materially, but then occur muscular twitchings, contraction of pupils, weakness of muscles, drowsiness, and in rare cases convulsions. There is neither dropsy nor urinous odour of the breath. The duration of life appears to vary from nine to eleven days.

2. **Non-obstructive Suppression.**—Sometimes in the course of acute inflammatory Bright's disease complete suppression of urine takes place. It may also occur in the later stages particularly of the inflammatory and cirrhotic forms of Bright's disease; also as a consequence of injuries and diseases of the urethra; and in the collapse stage of cholera and some other diseases. Doubtless in some of these conditions suppression is due to nervous agency, but how it is brought about is not at present understood. There are also cases on record in which complete suppression of urine has occurred in association with hysteria, persisting for days.

TREATMENT.—Next to removal, if possible, of the condition upon which the suppression depends, hot baths or fomentations, and the patient avoidance of active interference with powerful medicines, are among the most important indications. In cases of obstructive suppression, careful kneading of the abdomen may be tried; and this should be persevered with in the most advanced conditions, as cases are on record in which relief has been obtained when the prospect has been utterly unfavourable. In the female, the introduction of a sound into the ureter may be successfully practised. If relief be not obtained, and death be imminent, surgical interference may be necessary and practicable.

T. GRAINGER STEWART.

URTICARIA. — SYNON.: *Cnidosis*; Nettlerash; Fr. *Urticaire*; Ger. *Nesselausschlag*.

DEFINITION.—Urticaria is an eruption accompanied by sensations of stinging, itching, and burning, like those produced by the sting of a nettle, and is characterised by the formation of wheals.

SYMPTOMS.—Urticaria is a very common disease, and is remarkable for its very variable and fugitive character, and for the great variety of circumstances under which it is developed. In all cases, however, the presence of wheals or some equivalent eruption is pathognomonic of the disease. The wheal consists of a circumscribed swelling of the skin, attended with active congestion of the vascular layer, and an exudation of serum into the immediate neighbourhood of the vessels. This exudation does not usually extend into the epidermic structures. The degree of swelling is very variable, and depends on the amount of exudation. The occasional, almost sudden, disappearance of these curious formations is explained by the close proximity of the serous exudation to the absorbent vessels; for when the fluid finds its way into the epidermis, the process of resorption is much slower, and traces of the inflammation are often left behind for several days. Usually the central part of a fully developed wheal is pale, compared with the circumference. This is said to be due to the increased pressure of the exudation at that point, which is often so great as to empty the capillaries of the skin; it may, however, be caused by a spasmodic contraction of the muscular coats of the vessels. At all events, vaso-motor disturbance is always present in the formation of a wheal.

The size, form, and general appearance of the wheals vary greatly. Sometimes they are no larger than a split pea, while at other times they may occupy a considerable surface, and cause much swelling of the skin. In typical examples they are round or oval; not infrequently they take the form of streaks or irregularly shaped patches. Sometimes the only eruption consists of a diffuse erythematous bright red blush. But whatever be its form, it is very evanescent, and liable to appear and disappear almost suddenly, leaving little or no trace behind. In all cases the subjective phenomena are nearly the same, and consist in excessive itching, tingling, stinging, and burning sensations. Sometimes the itching preponderates, at other times, perhaps, the stinging and burning sensations are the most marked, for, like the eruption itself, they are liable to constant change. These subjective sensations are by no means always proportional to the amount of visible eruption, and often remain long after this has disappeared. The rash occasionally appears with a sudden outburst all over the body, while at other times it is developed more slowly, and appears successively on different parts. It is roughly symmetrical, though the wheals have no definite arrangement. Sometimes the mucous membrane of the mouth, tongue, and larynx is involved. The sufferer invariably rubs and scratches the skin. This greatly aggravates the symptoms, and brings out fresh wheals wherever the finger-nails are applied, and, in severe cases, small excoriations and little spots of coagulated blood may be seen scattered about the skin as the result of scratching. An ordinary attack of urticaria may last from a few hours to several days, and in chronic forms of the disease one attack follows so closely on another as to give the impression that they are continuous; this, however, is not the case, as there are always remissions and exacerbations, and generally short intervals of complete freedom.

Ætiology. — Urticaria is often only a symptomatic rash, and differs also from most other eruptions in the fact that it is a frequent attendant upon other diseases of the skin. The circumstances under which it is commonly met with may be divided conveniently into five groups: (1) It is extremely apt to complicate other irritable affections of the skin, such as scabies, phthiriasis, prurigo, and eczema. This is especially the case in children. The production of nettlerash under these circumstances is due to reflex action set up by scratching. (2) The bites and stings of poisonous insects, and the hairs of stinging plants, such as the common nettle, will produce in some people pretty severe local attacks of urticaria, so that the face or arms become much swollen and very painful. (3) Nettlerash produced by irritation of some part of the mucous tract is not uncommon, and belongs also to the group of reflex nervous actions. We often meet with examples of this kind dependent on uterine irritation from pregnancy and other causes; also in children who suffer from worms. (4) Certain kinds of food are apt to produce nettlerash; among these may be specially mentioned shell-fish, mushrooms, acid wines, and many kinds of fruit; but in these cases much depends on the idiosyncrasy of the individual. To this category belong the red rashes which are occasionally produced by certain drugs. Among the best known of these are copaiba, capsicum, turpentine, cubebs, and quinine (*see* Drug Eruptions). (5) The most common form of urticaria is met with in people in whom it is impossible to trace a definite exciting cause, or in whom the exciting causes are trivial and various. In these cases the disease is distinctly and wholly of nervous origin, and occurs in people whose nervous system has been overtaxed, being often associated with such nervous symptoms as neuralgia. This form of the disease is always recurrent. It may come on with great regularity at a certain time of the day, and even replace neuralgia. Urticaria is occasionally rheumatic.

Varieties of Urticaria.—In addition to the ordinary form there are three principal varieties of urticaria: (1) The acute febrile urticaria; (2) Urticaria papulosa; (3) Urticaria pigmentosa.

(1) *Acute febrile urticaria* is an idiopathic affection but rarely met with. It is ushered in with febrile symptoms, especially headache and sickness; the pulse and temperature may both be high, and the tongue furred. The characteristic feature is the suddenness of the attack, and the general outburst of red rash, which may cover the whole of the trunk, face, and limbs, and produce much swelling of the skin. The mucous membrane is also liable to be affected. This is especially the case about the fauces and throat, which become suddenly swollen, so as even to threaten suffocation. The disease may be distinguished from scarlet fever by the suddenness of the attack, the swelling of the skin, and the subjective sensations.

(2) *Urticaria papulosa* is a disease which is met with chiefly in children, and is commonly known as lichen urticatus; it is very obstinate, usually lasting for several years,

but with intervals of subsidence. The itching and irritation are very great, especially at night; this is always aggravated by the scratching of the patient. The eruption consists of wheals mixed with permanent pruriginous papules, which are probably the result of urticarial exudation into the cuticular structures. It is often mistaken for scabies, but does not especially affect those parts of the body which are liable to the attacks of the latter disease.

(3) *Urticaria pigmentosa* is a peculiar and rare form of persistent urticaria, associated with buff-coloured pigmentation of the skin. The eruption appears as persistent tubercles, and red measly-looking patches, mixed with yellowish pigment-spots, resembling pityriasis versicolor. The peculiarity of the colour, and the persistence of these spots, constitute the chief characteristics of this rare variety of urticaria. Usually, after the disease has lasted for some time, the neurotic symptoms subside, leaving simply raised patches of yellowish skin, either with or without tubercles; but the more active symptoms may be reproduced by rubbing and scratching.

TREATMENT.—As has already been stated, urticaria, unlike most other skin-diseases, is a symptomatic rash rather than a definite disease. That it is very difficult to deal with is proved by the vast number of different remedies recommended by writers on this subject. The first point in any given case is to ascertain whether there is any definite local cause of irritation giving rise to the nettle-rash; and with this view the skin should be carefully examined for bug-bites and pediculi, which are very common exciting causes among the poorer classes. It must not be forgotten that the dye or dressing of the underclothes is sometimes a local irritant to the skin. If we fail to find any external cause of irritation, our attention should next be directed to the alimentary canal. Worms in children are not an infrequent cause of urticaria, and injudicious feeding may be also mentioned as occasionally giving rise to it; therefore, in treating urticaria of this kind, a careful and well-regulated diet is in all cases indicated. With regard to medicines, those are most efficacious that promote the process of digestion; one of the most generally useful is a mixture containing carbonate of magnesium and bicarbonate of sodium, with some aromatic or bitter infusion, taken before each meal.

Subacute urticaria of the ordinary kind produced by poisoning from shell-fish or fungi or some other poisonous food, is best relieved by a simple emetic and a quickly acting saline purge, so as to remove the offending matter from the stomach and intestinal canal.

A large proportion of cases of chronic urticaria are distinctly of neurotic origin, and are often associated with other disturbances of the nervous system. Of all remedies for this class of cases, the most generally useful is complete rest both of mind and body. Of medicines, quinine and arsenic may be mentioned as often beneficial, especially when the attacks are of a periodic character. Complete change of air sometimes succeeds when all other remedies fail. The malady is, however, always very obstinate.

ROBERT LIVEING.

USSAT, in Ariège, France.—Thermal sulphated calcareous water. *See* MINERAL WATERS.

UTERUS, Diseases of.—*See* WOMB, Diseases of.

UVULA, Diseases of.—SYNON.: Fr. *Maladies de la Luette*; Ger. *Krankheiten des Zäpfchens.*—Suspended from the middle of the lower and free border of the soft palate is that small conical-shaped prolongation termed the 'uvula.' In structure it is exactly the same as—indeed it is a portion of—the soft palate, which consists of a fold of mucous membrane, enclosing muscles, aponeuroses, vessels, nerves, and glands, the latter being very numerous.

From its intimate relation with the soft palate, the fauces, the tonsils, and the pharynx, the uvula is likely to become involved when any of these parts is overtaken by disease. This is most evident in cases of catarrhal angina. It is extremely rare for the uvula to be primarily and exclusively attacked with *inflammation*, and yet instances of such an affection are on record. On the other hand, it is by no means uncommon to observe the uvula swollen, œdematous, and elongated, as a consequence of prolonged irritation, *relaxation*, or often-repeated catarrh of the fauces. That form of acute catarrh, of which the uvula partakes when the throat is the subject of this affection, disappears along with the other symptoms.

Elongated Uvula often proves very intractable to treatment for a long time, and all the more so that not very infrequently this morbid condition is entirely overlooked by the practitioner. It ought to be laid down as a rule, that the parts should be inspected in all affections of the throat. In this case, inspection will reveal that the uvula is greatly lengthened, but not of necessity always thickened or œdematous; so that when the patient reclines, this pendulous body falls backwards, sometimes even dropping so low as to reach the glottis. The consequence is, that the mucous membrane of the pharynx and larynx is kept in a continual state of irritation and general uneasiness. A peculiarly annoying cough is set up by the constant tickling of the parts, so that this condition of the uvula may even at times be recognised by the rapidly repeated, resultless, brassy cough. It may be described as a quick, ineffectual hack. An inclination to vomit is also induced. An irresistible desire to swallow is observed, owing to the sensation which the patient perceives in the throat, as if something were lodging there which ought to be got rid of by swallowing. If there should be much thickening as well as elongation of the uvula, then some slight difficulty may be experienced when deglutition takes place. When the elongation is very pronounced, and the uvula finds its way into the larynx, the patient may experience a sense of suffocation, particularly if he happen to be asleep, when he suddenly wakes up in a state of great alarm and breathlessness. A more temporary condition of elongated uvula is observed in that form of relaxed fauces to which public speakers and singers are subject, and which comes on suddenly, or quickly, after continuous use of the voice for an hour or more.

Treatment.—The condition associated with elongated uvula must be treated on general principles (*see* Pharynx, Diseases of). Locally, the elongated uvula is best treated by astringent gargles. One of the best of these, which is perhaps as soothing as astringent, is the bromide of ammonium gargle, twenty grains to the ounce of water. Glycerine of tannic acid, tincture of iodine, and other agents which are quite sufficient for the cure of the simply relaxed uvula, may prove insufficient to restore the elongated uvula, and then a portion of it must be removed, even to the extent of two-thirds.

Bifid Uvula is a deformity usually congenital, the treatment of which, if necessary, by the actual or galvano-caustic cautery, or other means, falls within the domain of surgery.

Paralysis of the Uvula is met with as a sequela of diphtheria, when other parts of the throat are similarly affected. *See* Palate, Diseases of; and Paralysis, Diphtheritic.

Claud Muirhead.

V

VACCINATION (*vacca*, a cow).—Synon.: Fr. *Vaccination*; Ger. *Kuhpockenimpfung*.

Definition.—Inoculation with the material of vaccinia or the cow-pox. Its purpose, as applied to the human subject, in which relation alone we have here to consider it, is the protection of the person vaccinated from an attack, and especially from a severe or fatal attack, of small-pox.

The cow-pox, which is a natural, though not common, disease in the cow and horse, never occurs spontaneously in man. Nor is it communicable to him by effluvia, or in any other way than by the direct inoculation of its own specific virus. Such inoculation before the time of Jenner was never more than a matter of mere accident, and occurred with comparative rarity. It was matter of popular tradition, but was left for Jenner to demonstrate, that persons who had thus been accidentally vaccinated enjoyed immunity subsequently from small-pox; and it was by his great discovery that the cow-pox, once implanted in the human subject, may be continued by inoculation from individual to individual indefinitely, that the practice of vaccination became possible.

The relation of cow-pox to small-pox is still a matter of some doubt, but on the whole the tendency of the evidence (which has been impartially summed up by Dr. McVail) shows that vaccinia is, as Jenner had supposed it, variola of the cow, and that the virus of human small-pox is so attenuated or metamorphosed in the bovine animal as to be deprived both of its quality of atmospheric convection, and of its tendency to cause a generalised eruption.

Phenomena of Vaccination.—The phenomena which follow inoculation with the material of cow-pox vary according as the person, in whom the vaccine lymph is inserted, may or may not have been the subject of a previous successful vaccination, a previous inoculation, or a previous small-pox. The description may be divided into (1) the course of *primary* vaccination; and (2) the course of *secondary* vaccination, or re-vaccination.

1. Course of Primary Vaccination.

This may be *regular*, *irregular*, or *complicated*.

(*a*) *Regular course.*—When lymph, taken from a vaccine vesicle at that period of its course when the vesicle is fit for the purpose, is inserted into the skin by puncture, or is applied to a small abraded surface of the skin, of an unprotected person, no particular effect is noticeable till about the end of the second day, or early on the third day. By this time, if the vaccination be about to succeed, a slight papular elevation becomes perceptible. This, by the fifth or sixth day, has become a distinct vesicle of a bluish-white colour, with raised edge and central cup-like depression.

By the eighth day (the day-week from that on which the lymph was inserted) it has attained its perfect growth ; it is then plump, round, more decidedly pearl-coloured, and distended with clear lymph; its margin is firm, and central depression very marked. On this day, or sometimes even by the end of the seventh day, a ring of inflammation, called the areola, begins to form about its base ; and the vesicle and areola together continue to spread for the next two days. The areola is circular, and when fully developed has a diameter of from one to three inches, being then often attended with considerable hardness and swelling of the subjacent connective tissue. After the tenth day the areola begins to fade ; and in two or three days more it has usually disappeared, with whatever of hardness or swelling may have existed. With the decline of the areola the vesicle begins to dry in the centre ; the lymph remaining in it becomes opaque and gradually concretes; and by the fourteenth or fifteenth day a hard brown scab is formed, which gradually contracts, dries, and blackens, and from the twentieth to the twenty-fifth day, but usually about the twenty-first day, falls off. There is then left a cicatrix, which is circular, somewhat depressed, foveated, sometimes radiated, and, with rare exceptions, permanent in after-life.

If the lymph have been inserted by two, three, or more punctures set near together about one spot, or by abrasion, over a sufficient surface, two or more vesicles may arise at the spot ; and in the course of their growth, either form a large vesicle of a compound character, with but one central depression, or a crop of vesicles, generally coalescing, but each retaining its own central depression. These compound vesicles and crops are round, oval, or of irregular outline, according to the manner in which the cutis has been penetrated or exposed ; and the shape of the resulting cicatrices varies accordingly. Vaccination which has gone through the course above described is held to be protective against small-pox.

The constitutional symptoms attending these local phenomena are a rise of temperature, sometimes detectable by thermometer as early as the fourth day, more marked but still often very slight from the fifth to the seventh day ; more obvious feverishness, with restlessness, and frequently derangement of the stomach and bowels, from the eighth to the tenth day, that is, during the stage of areola, subsiding as that subsides. The general symptoms are in most cases quite moderate, and often exceedingly slight. Occasionally, when the areola is at its height, swelling of the axillary glands may be intense ; and occasionally also at that period in young children of full habit, especially in hot weather, an eruption of roseola (*vaccine roseola*) may occur, chiefly on the extremities ; or a papular eruption (*vaccine lichen*) ; or a vesicular one—the vesicles, however, differing from vaccine vesicles in being entirely free from central depression. The duration of any of these forms of eruption, when they do occur, is very transitory, usually not extending beyond a week, and very seldom indeed beyond the falling of the scab.

(*b*) *Irregular course.* — The exactitude with which vaccination in the immense majority of cases runs the course above described is very remarkable ; but in some cases an irregular course is seen. The irregularity may be merely in point of *time* ; the development of the vesicle being retarded one or two or several days, or being slightly accelerated, so as to present, for example, by the eighth day, the appearances usually seen on the ninth. If the phenomena are in all other respects regular, these mere variations in time do not, as far as known, affect the protective power of the vaccination. On the other hand, there may be irregularity of the *character* and *course* of the vesicle, constituting *spurious vaccination*, on which no reliance can be placed for protecting from small-pox. Thus, papules or even vesicles may arise, which, instead of undergoing their proper development, begin by the fifth or sixth day to die away, leaving a mere scale or slight scab by the eighth day. More frequently, there are vesicles beginning early after the insertion of the lymph, with itching and irritation—symptoms almost invariably absent in a normal primary vaccination, assuming as they rise an acuminated or conoidal form, instead of the characteristic flat form with central depression; containing straw-coloured or opaque fluid, instead of clear lymph ; and developing an early and irregularly shaped areola, which is at its height by the fifth or sixth day, and far on the decline by the day-week. In other cases the vesicles, rising apparently more regularly at first, are found by the eighth day to have burst ; and present either an irregular scabby appearance, or are in the state of open sores. The chief causes of these irregularities will be discussed farther on.

(*c*) *Complicated course.*—In spurious vaccinations, especially in the kind last described, and even in the course of a regular vaccination, if the vesicles have been rubbed or otherwise injured, ulcerated sores may succeed, requiring, in children who are of scrofulous or otherwise unhealthy constitution, some time to heal. Occasionally, also, in children of such habit of body, the swelling of the axillary glands, which has been mentioned as sometimes attendant on the areola, may result in abscess. But the only complication which can be regarded as at all formidable is erysipelas. This disease may of course supervene on vaccination, as it may on any other surgical operation, when the conditions which ordinarily give rise to it exist, and especially where there has been exposure to its contagium. But there have been cases, happily rare, in which it has manifestly arisen from the use of improper lymph, that is, from lymph taken from spurious vesicles, or from regular vesicles at an advanced period of their course, or which has been spoilt in keeping.

Erysipelas was included by the Local Government Board in the list of diseases scheduled under the Notification of Infectious Diseases Act, 1889, mainly for the purpose of assisting vaccinators in guarding against this complication. Should a case of erysipelas or any septic disease occur in the home of an unvaccinated infant, vaccination should be postponed, or the infant should be removed to a locality free from infection for the vaccination period.

The place of operation should always be scrupulously guarded against the entry of dirt or decomposing matter, both *at the time* and *during the course* of vaccination.

2. **Course of Re-vaccination.** — In some persons the *regular* phenomena of vaccination can only be produced once in the lifetime. But this is not always the case, and vesicles may be produced by a second vaccination, not distinguishable in their appearance from primary vesicles, though usually having a smaller and more transitory areola, and having a small and poor cicatrix. Much the most frequently the result of that process is the production of a spurious papule or acuminated vesicle, with hard, irregular areola, reaching its height by the fifth or sixth day, and having by the eighth day an imperfect scab, which soon falls. There is often much itching and more serious local irritation; and the constitutional symptoms are out of all proportion more frequent after re-vaccination than after primary vaccination. In some persons no specific local effect is producible by re-vaccination.

PERFORMANCE OF VACCINATION.—(1) **Age.** Small-pox being a disease to which persons are liable from the moment of birth, and which is peculiarly fatal in infancy, it is of great importance that vaccination should be performed in very early life. In large towns, where a weekly supply of lymph from arm to arm can always be maintained, the vaccination of children who are plump and healthy should be effected within four or six weeks from birth. If the child be less robust, it may properly be deferred for three or four weeks more. In small towns and rural districts the age at which vaccination can be performed must depend to some extent on the arrangements for lymph-supply in the district; but these are always such as admit of a child being vaccinated within a very few months from birth. It is under ordinary circumstances a preliminary condition of the performance of vaccination, that the child to be vaccinated should be healthy; and a careful examination to ascertain this is the first duty of the vaccinator. The child should not only be free from any acute febrile disease, but also from diarrhœa and from cutaneous diseases, especially those of the vesicular type. The states of constitution associated with herpes and eczema singularly interfere with the proper course of vaccination, and seem to be the most frequent causes of those spurious results of vaccination just described. They may both —especially intertrigo — without care, be overlooked; hence examination of the scalp, and of the folds of skin behind the ears, in the neck, and in the groins, is indispensable. Vaccination should also be postponed if erysipelas be prevailing in the neighbourhood in which the child is living, or if it have been recently exposed to the infection of measles or scarlatina. There is, however, a state of things under which these conditions must be disregarded, namely, when there may be *immediate* exposure to the infection of small-pox, as when an unvaccinated child is in a house in which the infection exists, or has come into direct contact with an infected person. Under such circumstances, it cannot be too strongly impressed that no age is too early for vaccination, and no state of health, except the presence of acute disease of a serious character, can be held to contra-indicate it. Life then may depend on the promptitude with which the vaccination is done.

(2) **Selection of lymph.**—The second point to attend to is the selection of the lymph to be used in vaccinating. This may be of two kinds, bovine or human. Human lymph should be taken from primary cases only, from perfectly healthy subjects, and from thoroughly characteristic vesicles. Babies selected for the purpose should not only be in good health themselves, but, as far as can be ascertained, of healthy parentage. Those of dark complexion, not too florid, with a thick, smooth, clear skin, generally yield the best and most effective lymph. Vesicles from which the lymph may be taken must be well characterised, uninjured, and free from areola. Lymph may, with perfect propriety, be taken so soon as any can be obtained from a vesicle, as at the fifth or sixth day of its course; but it is then procurable in very small quantity, and is usually and most conveniently taken on the day-week from the vaccination, when the vesicle is perfectly formed, but before the stage of areola has set in. Any vesicle which at that date manifests areola must be discarded. This was Jenner's 'golden rule,' and one which ought to be scrupulously observed. Good vaccine lymph is always perfectly limpid, and has,

besides, a certain degree of viscidity. A thin, serous, too-readily flowing lymph should never be used.

The risk of conveying human disease is infinitesimal if the vaccination be done with due care. If bovine lymph be preferred to human lymph, the vaccinator should be equally careful in his selection of the source. That from which the Government supplies are obtained is the National Animal Vaccine-Lymph Station in Lamb's Conduit Street, London. The system of calf-vaccination has been in operation there since 1881. With the exception of a series of cases in 1885 and 1886 vaccinated with Simpson's lymph (obtained by the variolation of a cow), the only stock of lymph used since March 1882 had its origin in a case of natural cow-pox which occurred at Lafôret near Bordeaux, the lymph being supplied by Dr. Dubreuilh. Calves are vaccinated every week with this lymph on the shaven abdomen, the lymph being taken on the fifth day of vaccination for renewal of the stock, and for vaccination direct from the calf. Every precaution is taken at this establishment to ensure not only the healthiness of the calves, but the cleanliness of their surroundings. The lymph, besides being used for vaccination at the station, is supplied to vaccinators who require it in small quantities for the purpose of furnishing a fresh stock of lymph for 'arm-to-arm' vaccination. The lymph thus supplied to vaccinators should be used at once on being received. The 'insertion success' is, in the hands of Dr. Cory and other practised operators, about equal to that obtained by the established system of arm-to-arm vaccination. The resulting vesicles are in no way distinguishable from those produced by humanised lymph.

The chief advantage that belongs to the system of animal vaccination is, in the opinion of the present writer (Dr. Edward Seaton), that it may afford the opportunity of re-vaccinating simultaneously large numbers of persons who are exposed to the immediate danger of small-pox, as, for example, the inmates of a workhouse into which a case of small-pox has been introduced, and where the means of isolation are very imperfect. In order to facilitate the supply of lymph for such a purpose it would be well if several national or municipal animal-vaccine stations could be established near to large centres of population in the North and in the Midlands, as well as in the South of England; such stations to be open to the public like that at Lamb's Conduit Street, and to be available for supplies of lymph where the immediate re-vaccination of a large number of persons is necessary to prevent the spread of small-pox.

(3) **Method of collecting lymph: Arm-to-arm vaccination.**—The collection of lymph from the human subject for vaccinating is effected by opening the vesicle by numerous minute punctures on its surface, the utmost care being used not to draw blood. Should any accidentally be drawn, the vesicle must be discarded altogether. No lymph must be used which does not exude spontaneously; there must be no pressure or squeezing of the vesicle. The lymph which stands on the surface of the opened vesicle is taken on the point of a lancet or other instrument employed, and inserted in the arm of the child to be vaccinated. This may be done in various ways, as by puncture, by scratching, by scarifications or abrasions, by tattooing, &c. It would not be possible, within the limits of this article, to give any description of these various modes of operating. Nor would it be of much use. They should be learnt practically under a good instructor. All of these methods may, in careful and skilled hands, be made equally successful. That, however, which in the hands of practitioners generally Dr. E. C. Seaton found the most successful, was the plan by scarification or tattooing ·.·.·.· over surfaces of the extent here depicted. Insertions to this extent should be made on at least four, and preferably five, separate surfaces. If the vaccination be done on both arms, three insertions of this kind in each arm are recommended; if it be done on one arm only, then there should be five on that arm. In vaccination by other modes of procedure, care should be taken that local results to the full extent are obtained. An ordinary ungrooved lancet is the best of all instruments for the performance of vaccination. It is not only readily cleaned, but it is one concerning which we can always be sure that it *is* clean. Lancets used for vaccination should be kept bright, and should never be used for any other purpose. If used for more than one vaccination at a time, they should be most carefully cleansed after each case.

(4) **Storage of lymph: Indirect vaccination.**—Vaccination should, in all cases in which it is practicable, be done direct from arm to arm. The degree of success attending the use of conveyed or stored lymph, in whatever way the conveyance or storage be effected, does not approach that of lymph thus directly transferred. Where vaccination from the arm is impracticable, lymph intended for immediate use may be conveyed from case to case, in the liquid form, by means of the vaccine bottle and other contrivances for the purpose; but it must be a quite indispensable condition of this proceeding that the lymph be used within a few hours—six to eight at the outside—of its being taken. For longer keeping it must be stored either in hermetically sealed tubes, or on points thickly coated with it, then carefully dried, and kept afterwards constantly protected from damp and heat. When stored in the latter way, the

lymph needs revival before use by dipping the point for an instant in water, and laying it on the edge of a book, so that the lymph may become soft. In the use of stored lymph the process of vaccination by scarification or abrasion is always to be preferred.

(5) **After-treatment.**—When the vaccination has been done, the parent should be cautioned against allowing the vesicle to get rubbed or mechanically injured. The case should be seen again by the day-week at least, when, if the vesicle be perfectly formed, and pursuing a regular course, the success of the vaccination may fairly be pronounced. But if the case be then retarded, it should be seen again two or three days afterwards; or if there be anything abnormal in the appearance of the vesicle, the case should be watched unfailingly throughout its course.

VACCINATION AS A PROTECTION AGAINST SMALL-POX.—The protection which vaccination affords against small-pox is manifested in two ways: first, by the immunity from that disease which, as a rule, it confers; secondly, by the modification which, when immunity is not complete, it induces in the course and severity of the disease in the majority of cases. The most precise of the numerous facts which exist in proof of this are those derived from the Small-pox Hospital in London, where it has been found that, while small-pox in the unvaccinated patients runs an unmodified course in all but 2·6 per cent., its course in vaccinated patients is modified in 73 per cent.; and that while the death-rate of natural small-pox is 35·55 per cent., that of post-vaccinal small-pox is but 6·56 per cent. This latter figure, obtained from cases admitted into the Highgate Small-pox Hospital in the years 1836–1855, is lower than would be given from the experience of the Asylums Board Small-pox Hospitals during later years. The difference is due, in part, to the circumstance that Mr. Marson excluded what he called 'antecedent or superadded disease'; in part probably to the greater fatality of small-pox during more recent years, a circumstance which has also shown itself among the unvaccinated; and in part perhaps to the cases admitted to the latter hospitals belonging to a more destitute class of the community. In the Asylums Board Small-pox Hospitals, where all deaths are included, the post-vaccinal mortality has amounted to 8 per cent. The difference between 35 and 6, however, gives but a feeble idea of the protection which vaccination really affords, provided it be thoroughly done; for in nearly all the fatal cases the vaccination was found to have been of an imperfect character, and had not been done in accordance with the rules laid down above. The following table published some years ago, based on an examination of 5,000 cases, gives the results of Mr. Marson's observations, extending over twenty years:—

Classification of patients affected with Small-pox	Number of deaths per cent. in each class respectively
1. Unvaccinated	35
2. Stated to have been vaccinated but having no cicatrix . . .	23·57
3. Vaccinated:—	
(*a*) Having one vaccine cicatrix	7·73
(*b*) Having two vaccine cicatrices	4·70
(*c*) Having three vaccine cicatrices	1·95
(*d*) Having four or more vaccine cicatrices	0·55
(*α*) Having well-marked cicatrices	2·52
(*β*) Having badly marked cicatrices	8·82
4. Having previously had small-pox	19

Dr. McCombie and Dr. Gayton, of the Metropolitan Asylums Board, have recorded the experience of hospital-treated cases of small-pox in London since Mr. Marson's time. Dr. McCombie's table relates to the statistics of 11,724 cases of small-pox treated in the hospitals of the Metropolitan Asylums Board during the years 1871–78. Dr. Gayton's table relates to the 10,403 cases which have been under his own observation during twenty years of public service. The facts recorded by these two observers are entirely confirmatory of Mr. Marson's.

Dr. Russell and Dr. Barry, from the experience of the Glasgow and Sheffield hospitals respectively, have shown in a diagrammatic form the influence of vaccination in modifying the small-pox eruption.

In 1863 Dr. E. C. Seaton and Dr. (now Sir George) Buchanan showed by means of a school census of 50,000 children the relation of 'small-pox attack' to the quality of vaccination. It was recorded that of every 1,000 children having no vaccine cicatrices 360 were marked with small-pox; that of 1,000 with one vaccine cicatrix 6·8 had marks of small-pox; with two cicatrices, 2·49; with three cicatrices, 1·42; and with four or more cicatrices, 0·67.

Dr. Cory has compared the influence of good with inefficient vaccination from another standpoint. He noted the facts as to vaccination among 147 cases of persons scarred with small-pox who came under his observation at St. Thomas's Hospital and elsewhere—people all drawn from the same class of life, living under similar sanitary circumstances. In 147 cases, 83 were admittedly unvaccinated. In other words, the 5 per cent. of the unvaccinated population contributed over 56 per cent. of the persons scarred with small-pox. The average age of attack with small-pox amongst these 83 persons was seven years. On the other hand, the 95 per cent.

of the vaccinated population contributed 64 of the cases, or about 43 per cent. of the whole number; and, further classifying these cases according to the average age of attack from small-pox, this was found to be nineteen years among those who had three or four distinct vaccination marks. The difference therefore between being 'unvaccinated' or 'vaccinated successfully in four places' consists not only in a vastly diminished liability to any attack at all in the case of the latter, but also in a postponement of the age at which attack occurs amongst those who recover their susceptibility to small-pox after successful vaccination of the best kind.

To produce, then, at least four perfect vesicles, leaving four characteristic cicatrices, should be the aim of every vaccinator.

Re-vaccination.—The necessity for re-vaccination—a term the use of which should always be restricted to cases in which vaccination had already been performed *with effect*—has always been recognised in certain cases; but it is only of late years that its importance *as a practice*, after a certain period of life, has begun to be understood. (1) The cases in which later vaccination is most obviously required are those in which the effect of the first 'vaccination' has been of the irregular or spurious kind already described, from which no protection against small-pox can be assured. Circumstances must determine in the case of any particular child how soon a completer vaccination should be performed; but especial care should be taken, before proceeding to vaccinate again, to scrutinise the health of the child, and to correct anything in it which may be found amiss. The re-vaccination should be done with every precaution against failure, and therefore always, if possible, in cases of this kind, direct from the arm. If it totally fail, it will need, of course, to be repeated at intervals till some result is obtained. This result may be a complete success, but more frequently it will be only a modified success, with which, however, the practitioner will have to be content for the present. He will not fail, however, to impress the necessity for a further re-vaccination at puberty, or earlier if there be any immediate danger of small-pox. (2) When primary vaccination has been successful to a certain extent, but not to the extent desired—for example, when there have been one or two vesicles only instead of four or more, but these vesicles quite genuine—re-vaccination at puberty is of great importance, but need not, except under circumstances of immediate exposure to small-pox, be recommended earlier. (3) Following the foregoing rules, a practitioner who has to decide the question of re-vaccination in cases in which he did not himself perform or see the original vaccination, and who must therefore determine by the marks, would recommend re-vaccination as soon as practicable in cases in which the cicatrices wanted the true vaccine character, but would advise waiting when they were genuine in character and wanting only in number. (4) The systematic performance of re-vaccination at puberty is a practice, the importance of which must now be regarded as demonstrated. It is of course infinitely more important to those whose vaccination has been incomplete, than to those whose vaccination has been thorough, but even the best vaccinated derive additional security from it. When small-pox is of epidemic intensity, even the best vaccinated adults incur appreciable danger of attack; but with them the disease, if it do occur, is in the majority of cases mild and rarely fatal. Amongst re-vaccinated adults attack is rarer still and death is almost unknown. The reason why the period of puberty, or thereabouts, is fixed on as the time for the systematic performance of re-vaccination, is simply that it is only after that period that serious attacks of post-vaccinal small-pox are, as a rule, met with.

While adhering generally to the recommendations of Dr. E. C. Seaton respecting 're-vaccination at puberty,' *as a practice*, the present writer (Dr. Edward Seaton) would draw attention to the very important effects produced in this country by able sanitary administration combined with the 'systematic notification of infectious diseases.' By the help of this system, which is now very generally adopted by sanitary authorities throughout Great Britain, it should be easy, as the present writer knows from experience, for sanitary authorities to prevent the spread of small-pox. Always assuming our present system of primary vaccination to be maintained, spread of small-pox may be checked by isolation of the sick in hospitals, and by freely offering opportunities for re-vaccination of the best kind, *when and where it is most needed*. Under these conditions, re-vaccination, as a practice, may be safely left to the age of puberty, the sanitary authorities being relied upon to give special warning of danger from small-pox to persons concerned. The period of puberty is on the whole most suitable for re-vaccination, inasmuch as at later periods of life loss of valuable time may sometimes be entailed by the 'sore arm' which occasionally follows the operation.

In the case of persons going to the East or to countries where small-pox is a prevailing disease, subject to no such control as that which has been established in Jenner's country, re-vaccination should be recommended in every case except that of children under five years of age with first-rate primary vaccination marks, or that of persons who have already been successfully re-vaccinated in adult life.

Alleged Dangers of Vaccination.—The tendency of parents to refer to vaccination every disease, especially every cutaneous disease, which the child may afterwards manifest, is well known. Most of such allegations are without proof or probability—mere illustrations of *post hoc, propter hoc.* It is quite possible, indeed, that in some cases vaccination may, like teething or other irritative cause, hasten the evolution of a constitutional eruption which the child was incubating; but even this is not a common occurrence, nor is it at all within the meaning of the allegation. The only real danger which need be considered here (the danger of erysipelas having been already indicated) is that of the introduction of syphilitic infection along with the vaccine. Such an accident, though rare, is of the most serious consequence when it does occur, not only on account of the injury inflicted on individuals, but from the damage done by it to the reputation of vaccination; and every practitioner is bound to the most scrupulous observance of the precautions whereby these evils may be avoided. The precautions are (*a*) extreme care in the choice of vaccinifer; (*b*) brightness and cleanliness of lancet, with careful cleansing after each separate vaccination; (*c*) scrupulous care in opening the vesicles of the vaccinifer not to draw any blood, and not to use the lymph of any vesicle from which blood may accidentally have been drawn; and (*d*) care also not to take from lymph-vesicles in which there is an areola, and in which therefore the normal contents of the vesicle will have become mingled with the products of common inflammation.

E. C. Seaton. Edward Seaton.

VAGINA, Diseases of.

—Synon.: Fr. *Maladies du Vagin*; Ger. *Krankheiten der Scheide.*

The vagina frequently participates in the morbid processes which affect the uterus and other neighbouring organs. The vaginal affection is then a matter of minor importance, and may not call for special recognition. But this organ is often the seat of independent diseases, the more important of which will now be considered.

1. Atresia.—Imperforate vagina is met with as a congenital or acquired malformation. *Congenital atresia* may occur alone; or it may be complicated with absence, imperfect development, or closure of the orifice of the uterus. Occasionally the vagina is bifid, and the atresia affects only one side, in which the menstrual fluid of the corresponding horn of the uterus may accumulate, producing the condition described as *hæmatokolpos lateralis.* The occlusion may, first, affect the organ in its entire length; or, secondly, for a half or third of its length, most frequently towards the lower extremity; or, thirdly, it may be simply membranous, as from a too complete hymen. The congenital atresia is usually complete, so that the passage to and from the uterus is perfectly occluded. *Acquired* or *accidental atresia*, on the other hand, may present any degree of constriction, from a slight and partial narrowing of the canal up to its total obliteration. We find it resulting, first, from sloughing after labour, when it is frequently complicated with vesical or rectal fistulæ; secondly, from sloughing after fever; thirdly, from chronic inflammations and ulcerations; fourthly, from repeated applications of caustics.

Symptoms and Diagnosis. — There are three stages at which atresia of the vagina may betray itself by symptoms. First, after puberty has set in, the patient has the usual indications that ovulation is taking place, but she suffers from *amenorrhœa.* The uterine hæmorrhage is taking place; but the extravasated blood is detained above the seat of the occlusion, and does not appear externally. Secondly, in some women *dyspareunia* (impossibility of copulation) after marriage leads to the examination which discovers the obstruction. Thirdly, in the acquired variety the difficulty is often only discovered in consequence of the *dystocia* that results from the resistance offered to the advance of the fœtal head by the constriction of the canal. The physical examination may discover, first, on abdominal palpation, a swelling in the hypogastric or inguinal region, due to the accumulation of menstrual fluid in the upper parts of the sexual canals. Secondly, on vaginal exploration being attempted, either the finger is soon arrested within the labia, or a bulging fluctuating pouch is felt. Thirdly, we then examine *per rectum* or *per vesicam* with sound or finger, or through these cavities simultaneously, combining the exploration by means of the fingers of one hand through the available openings in the pelvic floor, with pressure and palpation with the other hand above the pelvic brim. The exact seat and extent of the occlusion can thus be detected, and at the same time an estimate can be formed of the amount of accumulation that may have taken place above it.

Prognosis. — (1) Where the obstructing membrane is thin, it may give way at a menstrual period, or under a gangrenous process. (2) The sac formed by the dilated uterine or Fallopian cavities may burst, and pour its contents into the peritoneal cavity. (3) In a considerable proportion of cases early menopause comes on, and lessens the risk. (4) Patients who suffer from atresia vaginæ, even when they have been relieved by operative measures, are said to show a tendency to die of consumption.

Treatment.—In view of the dangers associated with the accumulation of menstrual fluid in the genital canals, the indication usually becomes very clear for its evacuation by perforating the obstructing tissues. But this operation has often been followed by disastrous results. Not to speak of the risks of wounding the bladder or rectum, or of setting up pelvic cellulitis, in cases where there is total absence of the vagina, and a canal needs to be tunnelled to the uterus, emptying of a hæmatometra and hæmatokolpos has been followed by death, sometimes from septicæmia, sometimes from bursting of the sac above when pressure is made on it; or dangerous inflammation has been set up in the pelvic organs. Care must be taken never to empty the sac by pressure from above, but by washing it out with a warm antiseptic fluid through an opening, which may be made under antiseptic precautions. Where the atresia has been extensive, there is a strong tendency to its repeated closure. This must be averted by making the patient wear a glass or vulcanite tube, filled with cotton wadding soaked in carbolised oil, through which the uterine cavity can be occasionally washed out until it has collapsed. This must be worn for some months, until the vaginal canal has fully cicatrised around it.

2. **Displacements.** — When the perinæum has become relaxed or lacerated, hernia of the pelvic contents is apt to occur to a greater or less extent. The descent of the uterus in such cases has commonly been regarded as their most important feature, and they have generally been described as *prolapsus uteri.* When the protrusion or herniation, however, is complete, the walls of the hernial sac are formed chiefly by the walls of the vagina, and we get the most extensive displacement, or *inversion,* of the vagina. The symptoms and treatment of this inversion belong to the history of uterine displacements. But we may have displacement of one or other of the vaginal walls as an independent mischief, or as the most prominent disturbance, in a case where the retentive power of the pelvic floor is impaired. If the anterior wall of the vagina descend, it carries with it the back wall of the bladder—*cystocele.* If the posterior vaginal wall descend, it brings with it the anterior wall of the rectum—*rectocele.*

TREATMENT.—The treatment of these conditions is either palliative or radical. The palliative treatment is effected by the use of astringent injections, and the application of vaginal pessaries—such as the Hodge pessary with cross bars towards its lower end. The radical treatment implies a plastic operation for repair of the relaxed or ruptured perinæum, or for producing a contraction in the displaced vaginal wall.

3. **Foreign Bodies.** — The vaginal canal is sometimes found occupied by foreign bodies. Every gynæcologist has met with cases where pessaries have been left in for years, until by their presence and pressure they began to set up ulcerative processes in the vaginal walls. Introduced at first with a useful object, and producing for a time a beneficial effect, their presence has sometimes been forgotten, until the discharges they excited have recalled attention to them. But bodies of quite another kind are sometimes met with, usually introduced by patients with onanistic propensities. Corks, pieces of wood, pomade-pots, fir-tops, dram-glasses, &c., have been met with in such cases. Portions of glass specula and of glass syringes have sometimes broken off in the hands of practitioners or patients. Ascarides and other parasites seem occasionally to make their way from the anus into the vagina.

Some of these foreign bodies are very easy of removal. Others are a source of great difficulty—those more especially which have become embedded to some extent in the vaginal walls. Thus it may become necessary to anæsthetise the patient, to lay hold of the foreign body with a polypus forceps or vulsellum, and to detach it with the fingers or with a knife from the tissues that have granulated round it, before it can be withdrawn.

4. **Inflammation.** — SYNON.: *Colpitis*; *Vaginitis.*—Apart from gonorrhœal inflammation of the vagina, we may have colpitis of a non-specific character, either as a primary disease, originating in itself, or spreading to it from the neighbouring structures. The causes of inflammation commencing in the vagina are found in chills (puerperal or menstrual); injuries (as from rude use of obstetric and gynæcological instruments); prolonged presence of pessaries; excessive coition; irritants (as in cases where nitrate of silver applied to the cervix has acted on the vaginal mucosa); neoplasms; and some of the fevers. In elderly women we meet with a *colpitis senilis* or *vetularum* (Ruge), the cause of which is not easily traceable, in which the mucous membrane, especially of the upper part of the vaginal tube, sheds its epithelial covering in patches, becomes studded here and there with papillary granulations, and shows a tendency to cicatricial contractions. In other women the colpitis in its acute forms is found as a catarrh of the mucosa, attended with swelling, rapid desquamation of epithelial cells, and exudation of a serous fluid, which, mixed with the granular cells, produces a milky discharge. In the chronic forms the discharge becomes more creamy or purulent as the exudation is less copious, and there is more exfoliation of degenerated and often unripe epithelial cells; and then the surface is often thickly strewn with red papillæ, over which the epithelium is almost destroyed. The symptoms are local discomfort, and leucorrhœal discharges of various kinds; and the diagnosis is made by examination of the discharge, and exposure of the affected surface by means of the speculum.

Treatment.—The treatment in the acute stage is directed to keeping the part at rest, and using sedative injections. In the chronic forms the use of the injection or douche must be steadily persevered in. The canal must be washed out with a stream of hot water, in the last pint of which alum or some other astringent has been dissolved. Where an acute process is likely to become chronic, or in the chronic forms attended with granulations on the surface, it is well to apply with a mop or brush a solution of nitrate of silver containing half a drachm to the ounce. Frequently the use of pessaries of oxide of zinc, bismuth, or iodide of lead proves useful in cases where patients have difficulty in using the syringe or douche. In the *colpitis senilis* the distress which the patient feels from the irritating discharge is best relieved, and the unhealthy surface is most speedily brought to heal, by the application of bismuth powder, through a speculum or other tube, to the mucous membrane, after washing or wiping away the secretion; or an injection of boric acid with cocaine may be used.

5. **Injuries.**—It is principally in connexion with labour that the vaginal walls are liable to be injured. Not only in operative cases where the walls may get bruised and torn, or in tedious cases where the walls are so long compressed that they may afterwards slough and become the seat of fistulæ, but even in ordinary cases the vaginal mucous membrane is almost always fissured, or torn more or less deeply, at its lower extremity. These lacerations are mainly important because of their liability to become the channels through which septic matters are absorbed in the puerperal patient. In every case where there is a chance of infection, the canal should be syringed with a solution of creolin, or perchloride of mercury, or carbolic acid; and it is a further safe precaution to keep the raw surface dusted with a powder of several grains of starch combined with one grain of salicylic acid, or with iodoform and bismuth.

6. **Neoplasms.**—*Fibromata* affect most frequently the anterior wall of the vagina. They may be either sessile or pedunculated. They do not give rise to much distress, except from their pressure on the bladder, or from their protruding through the vulva. Extirpation affords the only cure, and in carrying out the operation care has to be taken to avoid injuring the bladder or urethra when they are seated anteriorly, and the rectum when they spring from the posterior wall. *Sarcomata*, round-celled or spindle-celled, have been in some few cases found springing from the vaginal walls. They have sometimes been described as growing from the submucous tissue; and the writer has seen them in two instances develop from the submucous tissue of the back wall. In other cases the growths arose from the mucous membrane. Early extirpation is indicated. These growths tend to recur. *Carcinoma*, more markedly even than the other neoplasms, is oftener a secondary than a primary affection in the vaginal walls. It may, however, originate in the vagina itself, running a course at least as rapid as in the uterus, and usually leading early to infiltration of the inguinal glands. It only admits of palliative treatment. *Cystomata*, like the simple solid tumours, are most frequent on the anterior wall. The contents are usually pale, and, where they have attained the size of a walnut, watery. In the smaller cysts the contents are more viscid. Some seem to result from cavities into which blood has been extravasated, and then the contents are brownish. They must be freely evacuated, and iodine or nitrate of silver applied to their lining membrane; otherwise they are apt to be re-filled.

7. **Vaginismus.**—Under this designation has been described an affection of the vaginal orifice, which is not infrequent among recently married women, and which utterly unfits the subjects of it for enduring coition. In some of them the hymen is unruptured, and there are excoriations at its base, towards the navicular fossa. More frequently the hymen has been infringed, but the lacerations have not healed, or fissures have formed at the roots of the hymeneal flaps, and a chronic inflammation is set up in the tissues, which renders them exquisitely sensitive. In such a condition any touch, even of the finger, causes intense pain, and when an attempt is made to pass through the orifice, the constrictor vaginæ and the lower fibres of the levator ani are thrown into a tenesmic state, which prolongs the suffering. The leading symptom is the distressing dyspareunia; and the diagnosis is made by the touch of the finger, supplemented by inspection. An examination can often be effected only when the patient is placed under an anæsthetic.

Treatment.—Treatment of a palliative kind may be attempted, making the patient use sitz-baths and apply emollients and sedatives. But it is far more satisfactory to have recourse to radical measures. The patient being under the influence of chloroform, the fragments of the hymen should be pared or clipped off. An incision should be made on each side of the vaginal opening towards its posterior aspect, running in a direction outwards and backwards, and passing through the whole thickness of the mucous membrane and some portion of the thickness of the constrictor muscle. The points of four fingers of the hand, gathered together and well greased, should then be passed through the dilated opening, so as fully to distend it, and produce complete relaxation of the sphincter. With due care the bleeding is trifling; the wound heals kindly; and undue contraction is prevented by making the patient wear, for half an hour or longer twice a day, a thick vaginal bougie. For a time the introduction of the bougie is resented, but the pain passes off when it is kept in position; and after a few days its passage ceases to be painful. This operation can be carried out with a very confident expectation that the dyspareunia will disappear; and if no other complication be present, the probability is that conception will ensue.

Alexander Russell Simpson.

VALENCIA, on the East Coast of Spain. — A dry, variable, mild, winter climate; and important sea-bathing station. Mean winter temperature, 57° F. Prevailing winds E. (moist), W. and S.W. (rough). *See* Climate, Treatment of Disease by.

VALS, in Ardèche, France.—Alkaline waters. *See* Mineral Waters.

VALVES, Diseases of.—*See* Heart, Valves and Orifices of, Diseases of; and Pylorus, Diseases of.

VARICELLA (dim. of *Variola*).—A synonym for chicken-pox. *See* Chicken-Pox.

VARICOCELE (*varix*, a dilated vein; and κήλη, a tumour).—Synon.: Fr. *Varicocèle*; Ger. *Krampfaderbruch.*

Definition.—A dilated, elongated, and tortuous condition of the veins of the spermatic cord, due either to increased pressure within the vessels, or to diminished resistance in the walls of the vessels and the surrounding structures.

Pathology.—The testicle, probably like other glands, receives supplies of blood varying with its activity; and the veins are numerous and tortuous, freely anastomose, are liable to intermittent compression in their passage through the inguinal canal from muscular contraction, and terminate on each side in a single vein, which, like the companion artery, is remarkable for its great length and small size. These conditions are favourable to the production of dilatation and varicosity. Diminished resistance in the walls of the vessels and surrounding structures is, however, probably the chief cause. Varicocele is so much more frequent in the left than in the right spermatic cord, and when present in both is so much larger in the left, that the inferior muscular development of the left side of the body from predominant use of the right is very possibly a predisposing cause. The termination of the left spermatic vein at right angles in the renal vein, as compared with the termination of the right vein at an acute angle in the inferior vena cava, and the relation of the left vein to the sigmoid flexure, have been suggested as possible exciting causes; but their influence, if any, must be slight.

Symptoms.—Varicocele is generally painless, but is sometimes associated with neuralgia or hyperæsthesia of the testicle. The subjects of it sometimes complain of a feeling of weight or uneasiness in the part, after standing or prolonged exercise; and in extreme cases, when the scrotum is very much relaxed, labouring men have found it a mechanical hindrance in their work. The testicle is in many cases normal, but is sometimes soft and even atrophied, but these conditions of the testicle are probably the result of other causes, and not of the varicocele. In such cases the patient is generally very hypochondriacal.

Diagnosis.—The diagnosis is easy. The veins can be readily felt, and have been aptly compared to a bag filled with worms.

Treatment.—In slight cases of varicocele no treatment is required. The use of a light truss, with pressure sufficient to take off the weight of the superincumbent column of blood from the spermatic veins, without interfering with the current of blood through the spermatic artery, has been recommended with advantage. A well-fitting suspensory bandage, cold bathing, avoidance of constipation, and tonics, will suffice for most cases; but if operative interference be requisite, the writer has found excision of the veins, with antiseptic precautions, most satisfactory. Subcutaneous ligature and division of the veins have been recommended; but the result is always uncertain, and sometimes unsuccessful.

Jeremiah McCarthy.

VARICOSE VEINS.—*See* Veins, Diseases of; and Varicocele.

VARIETIES OF DISEASE. — *See* Disease, Types and Varieties of.

VARIOLA (*varius*, spotted). — A synonym for small-pox. *See* Small-Pox.

VARIOLOID (*variola*, small-pox; and εἶδος, form).—This term has been applied to a mild form of variola, the disease being modified by previous vaccination or inoculation. *See* Small-Pox.

VEGETABLE PARASITES.—*See* Parasites.

VEGETABLE POISONS.—*See* Poisonous Food; Mushrooms, Poisoning by; and Poisons.

VEGETATIONS.—In modern pathology this term is generally applied to growths and deposits connected with the valves of the heart (*see* Heart, Inflammation of). The name is also given to excessive granulations on wounds, and to warty growths in any situation.

VEINS, Diseases of. — Synon.: Fr. *Maladies des Veines*; Ger. *Krankheiten der Adern.*

The diseases of veins will be described in the following order: (1) Inflammation; (2) Varix; (3) Hypertrophy; (4) Atrophy; (5) Degenerations; (6) Phleboliths; (7) Wounds; (8) Air in Veins; (9) Parasites; and (10) New-Growths. Neither thrombosis nor pyæmia, except in so far as they affect the vessel-walls, will be discussed here. Until late years, the term 'phlebitis' included these diseases and many others, but they have been gradually separated now (*see* Pyæmia; and Thrombosis). The subject of the entrance of air into veins is also separately considered. *See* Veins, Entrance of Air into.

1. Inflammation.—Synon.: Phlebitis; Fr. *Phlébite*; Ger. *Venenentzündung.*

Definition.—Inflammation of the coats of a vein.

Classification.—Cases of phlebitis may be classified: (1) according to the *intensity* of the inflammation—acute, subacute, or chronic; (2) according to the *result* of the inflammation—whether the formation of new tissue (plastic) or suppuration (suppurative); (3) according to the *layer of the venous wall primarily or chiefly affected*—endo-, meso-, and exo-, to which may be added as closely associated peri-phlebitis; or (4) according to the *cause* of the phlebitis, *e.g.* septic. Practically, however, we may discuss the subject under two heads, namely, *endophlebitis* and *periphlebitis.*

Ætiology.—The following are more or less well established causes of phlebitis:—

Mechanical injury.—This frequently, but not necessarily, leads to the formation of a thrombus—a further source of mechanical irritation. A wound of a vein is generally lost sight of in the injury of surrounding parts; but the degree of inflammation resulting in the vein-wall, like that in the wound at large, will depend upon whether the injury is or is not accompanied by infection with pyogenic organisms, or whether these subsequently gain access to the injured spot. The effect of chronic strain is shown in the thickening and sclerosis of the wall of a varicose vein.

The formation of a thrombus.—For the causes of this *see* Thrombosis. Here it will suffice to say that a certain unknown degree of alteration, by injury or disease, of the endothelial layer of a vein will induce the formation of a clot, and that this is favoured by slowness of the circulation and by some blood-states. The clot is an irritant, slight or intense. When the thrombus quickly clears up, and the vein becomes patent, we may presume that the changes in the vein-wall have been but slight; when the thrombus is the seat of infective softening, the wall of the vein may suppurate or necrose. Between these two extremes come the changes accompanying the 'organisation of a clot,' and the conversion of it and the vein-wall into a mass of fibrous tissue.

The existence of an inflammation in the tissues through which the vein passes.—When a periphlebitis exists, whether acute or chronic, it tends to spread to the wall of the vein, involving first the adventitia, and extending inwards until, perhaps, sufficient change of the intima is produced to cause thrombosis. The intensity of the phlebitis varies with that of the surrounding inflammation, but it does not follow that a venous wall exposed in an abscess will become the seat of abscess, nor even that it will be thrombosed, for the vein is not one with the tissue in which it lies. Still, it is not difficult for organisms in tissues round about a vein to invade the wall of the vein, to excite in it a process similar to that going on around it, and to penetrate to any thrombus which may form within it, causing it to undergo infective softening. The veins suffer in organs and parts which are the seats of chronic sclerosing processes, which extend to their external coats, causing fibroid thickening, and contraction of their lumina. Gummatous and tubercular infiltrations of veins passing through parts which are the seats of late syphilitic or tubercular lesions occur; and the degeneration of a tubercular lesion of a vein-wall may lead to discharge of the contents of the focus into the circulation, and a more or less widespread outbreak of tuberculosis.

But *syphilis* and *tubercle* may affect the walls of veins directly, giving rise to small gummata and discrete tubercles in the walls. The former lead to changes similar to those in syphilitic arteritis. Either syphilitic or tubercular inflammation may lead to sclerosis of the wall with contraction of the lumen, and, very likely, thrombosis.

A hyperplastic phlebitis is described, corresponding to endarteritis obliterans, but it is even less common, and the subendothelial thickenings are much less marked. The cause is unknown.

There is no *à priori* reason why acute inflammation excited by the presence of organisms should not start in the external and middle coats of veins, which are vascular; but there seems to be no pathological evidence of its occurrence. On the other hand, it seems probable that blood-borne germs do settle in the intima of veins in acute necrosis and in pyæmia, and induce such changes as lead to thrombosis. Again, if the changes in acute rheumatism in the non-vascular cardiac valves are not always due to organisms settling upon them, but are caused by some irritant in the blood, the vessels may be similarly affected; there is, however, nothing but theory to support this view. The recurrent phlebitis to which the gouty are liable may possibly own a pathology of this kind.

To sum up: the great causes of phlebitis are injury, the irritation of a thrombus, and the spread of inflammation from without.

Morbid Anatomy and Histology.—When a thrombus forms, contraction of the vessel-wall and uniform reddish staining of the intima occur, exactly corresponding to the clot. The inner wall presents longitudinal folds, easily obliterated by distension. More or less injection of the vasa vasorum, more or less fluid and cellular infiltration, and consequent swelling and softening of the vein-wall, ensue, in proportion as the clot is more or less irritant. If the clot soon disappears, return to the normal is easy. If the clot organises, contraction of the vein upon the clot goes on; the clot is freely infiltrated by leucocytes from the vasa vasorum, and proportionately decolorised; new vessels form; fibrous tissue develops; and wall and clot are converted into a cord of connective tissue, in which the structure of the vein may for a long time remain more or less distinct. If the clot undergoes infective softening or putrefaction, the swelling and softening of the wall reach their greatest height; hæmorrhagic points and small collections of pus may be visible to the naked eye; under the microscope the wall is densely infiltrated with white and red corpuscles; and, finally, loss of fine structure and imperfect staining may indicate death of the part. The thrombus which has undergone infective softening may thus give rise to an abscess about the vein, and may burst through the venous wall—the most favourable termination; for it may ward off rupture of the central end of the clot into the circulation, and consequent septic embolism. These changes are well seen in cases of pyæmia, and in thrombosed veins starting from septic ulcers or wounds.

Exactly the same state of matters may be produced by a septic inflammation extending from without to the venous wall, and leading to thrombosis and infective softening of the thrombus, *e.g.* in thrombosis of the petrosal and lateral sinuses in middle-ear disease.

Symptoms.—Thrombosis of a vein—generally of the leg—is usually spoken of as 'phlebitis.' The patient complains of pain in the part, either dull aching or sharp shooting; and on examination one feels a firm rounded cord, if the affected vein is superficial. The part is somewhat tender, there is usually slight œdema around the cord, and the skin over it may be slightly or markedly reddened; these symptoms being due, apparently, to thrombosis causing a phlebitis and periphlebitis. Some, however, believe that these symptoms may arise from phlebitis without thrombosis, an inflammation spreading outwards from the wall of the vein. In the case of deep veins of no great size there may be no symptoms at all to indicate the occurrence of simple thrombosis, and it is evident from what we see in superficial veins that thrombi may cause very little irritation. When the vein thrombosed is a main one, more or less widespread œdema results, but this is a symptom of thrombosis, not of phlebitis.

When the thrombus undergoes infective softening, the vein-wall and the tissues for some distance round about it become the seat of an intense inflammation, the signs of which are obvious in the case of superficial veins; and in deep veins, like the jugular, fulness and tenderness along its course may be discovered. On the other hand, nothing used to be commoner than the occurrence of pyæmia, without any symptoms to guide the surgeon to the vein which was occupied by the breaking-down clot, unless a characteristic œdema was present.

No fresh symptoms accompany the spread of inflammation to the wall of a vein passing through a focus of inflammation, unless, again, thrombosis of it occurs and induces œdema.

Formerly, when almost all wounds suppurated, the thrombi which formed in veins, cut across in operations, were frequently infected with pyogenic and septic organisms, and the veins of bones which did not collapse on section were more liable than those of soft parts to infection. The result of the infection was sometimes a continued thrombosis of the vein, with infective softening of the clot, and thus arose a progressive phlebitis and a progressive inflammation of the tissues about the inflamed vein which, perhaps, ended in abscess. On the other hand, a very similar clinical result was produced by a septic inflammation of the lymphatics around the vein, leading to abscess in their course and, perhaps, to phlebitis by extension, and thrombosis with infective softening. These two conditions, forerunners of pyæmia, went by the name of *suppurative phlebitis*, and ranked high among the septic diseases of wounds.

Prognosis.—In a simple phlebitis, not connected with a septic wound or an inflamed mucous membrane, the prognosis is good, as regards life. Serious embolism is *the* danger, but with ordinary care the probability is that the clot will completely disappear, and the vein become again pervious, or that it will become organised, and the vessels of the new connective tissue will establish a more or less complete communication between the parts above and below the obstruction. Thus œdema will be more or less completely removed. In infective phlebitis and thrombosis the prognosis is almost, if not quite, as serious as in former days.

Treatment.—In all forms of phlebitis we must ensure absolute rest by confining the patient to bed, and by fixing the whole limb between sand-bags, or by means of splints. This is essential to procure diminution of pain, and to lessen the chance of breaking off a fragment of the clot, whereby fatal embolism might be caused. Glycerine and belladonna smeared on the part, and hot fomentations or linseed poultices, are by far the most agreeable and soothing application. When abscesses form, they should be incised and dressed with fomentations wrung out of hot 1·2000 perchloride of mercury lotion. Any œdema or general thickening that may remain must be combated by Martin's elastic bandages and regular massage, after all danger of embolism is over. Medicines, except those given to support the patient's strength, such as bark and ammonia and the like, are not indicated. Opium is given only to allay pain, and the less the drug is used for that purpose the better. The treatment of peri-, suppurative, or diffuse phlebitis is to be conducted at first on the same principles; but the further treatment is discussed under PYÆMIA. *See* PYÆMIA; and THROMBOSIS.

2. **Varicose Veins.**—SYNON.: Varix; Phlebectasis; Fr. *Varice*; Ger. *Krampfader*.

DEFINITION.—Veins which are dilated and out of proportion to the quantity of blood which should pass through them: wherefore the current in them is slowed.

ÆTIOLOGY.—It is conceivable (1) that a wall of a vein may yield under normal intravenous pressure; (2) that it may be dilated by increased intravenous pressure; or (3) that it may be dragged open. The last cause is probably at work when dilated veins are found traversing cicatricial tissue—*e.g.* in an organising thrombus—but it is of little importance as compared with the others mentioned.

(1) Although varicose veins are not inherited, the tendency to them appears to be hereditary. The walls of any given vein vary markedly in strength in different individuals, and at different spots in the same individual. Saboroff has demonstrated these variations in strength and thickness of wall for the saphenous system. Weakness of venous walls may probably be acquired. Although we have no very certain knowledge about it, it is probable that from impaired circulation in a part malnutrition and degeneration of the walls of the veins in it will result, and that this degeneration will chiefly affect the contractile element, the loss of which is not compensated by increase in the inelastic, non-contractile fibrous element. Again, small varicose veins are common on mucosæ which are the seats of chronic catarrh, but their ætiology is complex. It is well known that under conditions of fatigue and exposure to heat, especially in air containing much moisture, the superficial veins dilate and form prominent objects on the surface; also, that in some persons this effect of 'relaxing' conditions is felt much sooner than in others. Thus a temporary weakness of the venous walls is produced; and if the conditions of life bring about this effect frequently, normal intravenous pressure may lead to permanent dilatation of veins—those which are weakest congenitally or owing to degeneration of muscle yielding first.

The 'normal intravenous pressure' is the sum or difference of the driving force of the heart, the aspirating force of the thorax, and of gravity. These may coincide in their action, or gravity may oppose the other two, and does so especially in the lower limbs and lower parts of the trunk, where the veins are thicker walled in proportion to the strain which they have to bear. The effect of gravity on a vein-wall is proportionate to the height of the column of blood in the vein, and is therefore greater in the lower limbs of tall than of short people; its effect is constant as long as the height of the column of blood in the vein and the lumen of the vein are unaltered. Retardation of flow, due to diminished driving force, diminishes the intravenous pressure; but when due to obstruction to venous return, it is accompanied by rise of pressure. But the element of *time* is a most important one in considering the dilating action of the normal pressure. No tissue in the body is able to bear, continuously or repeatedly, for long periods the maximum strain which it is capable of bearing without at once yielding. The more perfectly contractile, the more perfectly elastic it is, the longer will it withstand such trials; but, sooner or later, it will fail to recover perfectly—that is, permanent dilatation will begin. The veins are neither highly muscular nor elastic, yet they may recover from considerable and repeated dilatation, lasting even for months, as we see frequently in childbearing women.

The withdrawal of support which is usual may lead to dilatation of veins under normal pressure; thus a lax sphincter may encourage the development of piles.

(2) That heart and lung disease may cause accumulation of blood in the veins, and that these, especially the abdominal veins, dilate to accommodate it, is certain; but such general obstructions to the venous return are not causes of varix. There seems some reason to doubt the correctness of the view, held by many, that cirrhosis of the liver is a direct cause of piles. When a main venous trunk becomes thrombosed or is compressed by the gravid uterus, full rectum, aneurysm, tumour, &c., dilatation of its tributaries and œdema may result; or a collateral circulation may open up through neighbouring veins, the walls of which may simply hypertrophy; or certain veins may become varicose. As Saboroff says, the vein behaves in response to increased pressure like the bladder or heart; at first the muscle-cells hypertrophy, and then, if new vasa vasorum are developed and fuller nourishment is granted, the adventitia increases in strength; but if nourishment fails, the vein atrophies and dilates progressively. In aneurysmal varix

and varicose aneurysm intravenous pressure is approximated to arterial; the veins dilate and thicken greatly. It is believed by many that frequent and powerful muscular contractions, and the accompanying great affluxus of blood to the muscles, lead to the throwing into the veins of quantities of blood larger than they can accommodate, and thus to their permanent dilatation. Even the effect of long standing on the leg-veins has been explained thus, the calf-muscles being specially active; this, at least, seems very doubtful. Walking, short of excessive fatigue, probably promotes the nourishment of all tissues in the leg; but when it and such exercises as cycling are carried to excess—that is, to great fatigue—they may, perhaps, lead to dilatation of veins.

Anatomical Characters.—The principal seats of varix are the lower extremities; the body, when collateral circulation is set up as the result of blocking of the venous trunks; the rectum (*see* Hæmorrhoids); the spermatic plexus (*see* Varicocele); and the ovarian veins. But almost all veins have occasionally been found varicose—large and small, deep and superficial, a single vein or venule or almost all in the body.

The following changes occur in the development of a varicose vein:—

(*a*) Simple dilatation of a vein occurs when unusual strain is thrown on its walls.

(*b*) If the strain endures, and increased blood-supply is sent to the vein-wall, hypertrophy of the muscle-cells in the middle coat, and hyperplasia of the connective tissue in all the coats ensues. So far the vein is merely hypertrophied in proportion to the demands made upon it.

(*c*) Should the excessive strain continue, the vessel yields in all directions, becoming wider and longer, but not regularly: thus it becomes tortuous and irregular in its outline and calibre. Its wall is abnormally thick at some spots, very thin at others, especially in the neighbourhood of valves and towards the free surface.

The valves, too, become hypertrophied, and for a time perform their function; but by-and-by they fail to span the widening stream, and waste to fibrous cords. In the sac-like or spindle-formed dilatations behind the valves the blood frequently coagulates, and the thrombus may remain small and parietal, occasionally calcifying (phlebolith), or may grow and become obstructing. *See* Ulcer and Ulceration.

(*d*) A sac-like dilatation of the vein, as it approaches the surface, may by its pressure cause thinning of the superficial tissues; and these, together with its own walls, may finally rupture.

(*e*) The tissues round a varicose vein may appear normal, are frequently slightly œdematous, or hard and fibroid, and perhaps there is evidence of shrinking of the new fibrous tissue. In this dense tissue the veins seem to lie in definite channels. The explanation is that the circulation is slow in proportion to the dilatation of the veins, and the tissues are under-nourished, yet are kept soaked in a transudate of poor quality, which leads to thickening of the connective tissue. Such tissues offer little resistance to the causes—especially infective—of inflammation. Thus spontaneously, or as the result of injury or of rupture of a vein, ulcers but little prone to heal develop. *See* Ulcer and Ulceration.

Symptoms.—It is not until veins are seen or felt to be varicose that the disease can be known to exist. When first seen, a small part of a superficial vein, usually about the calf or ankle, looks slightly more bluish and larger than usual. This may disappear for some time—only, however, to recur; and by-and-by the condition will become permanent, and may spread to other veins. There may be no pain with very large veins; but patches of very small varices are often very painful—probably from pressure on nerve-endings.

A limb may be somewhat swollen, and pit on pressure; or it may be hard from fibroid thickening. Here and there saccules may cause localised soft prominences; and signs of old or present inflammation are common. Ulcers often form in connexion with varicose veins.

When a varicose vein bursts, hæmorrhage is likely to be excessive, more blood pouring from the upper than from the lower end of the vessel, the valves between the rupture and the heart being incompetent.

Diagnosis.—Varicose veins are unmistakable in their appearance as usually found. A saccular dilatation of the internal saphena vein, just below Poupart's ligament, has been mistaken for a femoral hernia; but there is no excuse for the error unless the sac be thrombosed, when the diagnosis from irreducible hernia may be impossible.

Prognosis.—The dangers of varicose veins are: Ulceration; thrombosis; phlebitis, simple or infective; embolism; rupture, and hæmorrhage. Much relief can be given by treatment, but cure can hardly be spoken of except in limited cases.

Treatment.—The treatment in any particular instance is to remove the cause of the veins becoming varicose, if possible. The circulation in the dilated vessel must then be encouraged, by obtaining a good cardiac and vascular tone; by support of the vein; and by particular attention to dietary and hygienic rules for some time. The vein is best supported by an elastic stocking, or by Martin's elastic bandage, or by a carefully applied roller-bandage. To help the venous return, the patient when sitting should have the feet raised on another chair, and at night should sleep with the lower end of the bed slightly raised. Cold-water bathing, followed by firm rubbing with a towel upwards towards the heart, is useful. Rules of treatment such as these are no doubt beneficial but, unfortunately, are but seldom curative.

The cases in which it is considered justifiable to operate are (1) when the vein gives rise to pain and inconvenience; (2) when hæmorrhage threatens; (3) when ulceration threatens or is present; (4) when a patient wishes to enter the public services.

The operation usually practised in this country is that of excising between double ligatures a few bits of the varicose trunks and branches, choosing such portions as will best interrupt all circulation through them; the unused vessels then waste. The little wounds almost always heal by first intention. The operation is easily done under cocaine, either in the leg or in the spermatic cord. Embolism is the danger, but rarely occurs. Other veins may dilate sooner or later after the operation.

3. **Hypertrophy of Walls.**—This takes place when extra work is thrown on the walls of the vessel, and is accompanied by increased blood-supply. *See* 2. Varicose Veins.

4. **Atrophy.**—When from any cause a vein, or part of a vein, falls into disuse, as after an amputation, its calibre diminishes, and its coats atrophy, until it finally disappears.

5. **Degeneration.** — Degenerations in veins are probably similar to those occurring in arteries; but less is known about them. Calcareous plates are found at times in the saphena veins, inferior vena cava, and uterine veins.

6. **Phleboliths.**—Phleboliths, or venous calculi, tend to form in veins in which circulation is slow, as in the veins of the prostate and bladder, and in varicose veins anywhere. They commence no doubt as precipitated fibrin, which becomes infiltrated with the less soluble salts of the blood—chiefly phosphate of calcium, and in less quantity the sulphate of calcium and sulphate of potassium. Phleboliths are harmless, and require no treatment.

7. **Wounds, and Process of Healing.** *Wounds.*—When a healthy superficial vein is wounded, dark venous blood flows in a uniform stream from the distal end; in the case of a varicose vein the blood flows from both ends, but chiefly from the cardiac. At the same time a quantity of blood escapes into the subcutaneous areolar tissue and around the sheath of the vein. When a deep vein is wounded with a breach of surface, dark, scarcely fluid, blood oozes and trickles away. When a deep vein is torn by a broken bone, without breach of surface, the part around swells, and becomes dark in colour; œdema occurs around and below the torn vein; and the fate of the limb will vary with the amount of the extravasation and the importance of the wounded vein.

Healing process.—When gentle pressure is applied over the wound after venesection, and the limb is kept at rest, union takes place in a few days, so that no scar even can be found in the injured vein. The coats of a vein contract and retract only to a slight extent within the sheath, but still sufficiently to help in the arrest of the hæmorrhage and the formation of the clot. The extravasated blood coagulates, extends through the opening in the vein, and projects like a button into the blood-stream. The whole coagulum now contracts; the part projecting into the vein becomes organised; and finally it helps to close the wound. The vessel may not become obstructed, or, if it does, is soon opened up again. Instead of this favourable ending, there may arise, from excess of movement or inflammation, numerous troubles, such as complete obstruction of the vein, phlebitis leading to thrombosis and the dispersion of emboli, local suppuration, inflammation of the lymphatics, or pyæmia.

TREATMENT.—Hæmorrhage from a superficial vein is readily arrested by pressure over the wound, and elevation of the limb. In the event of persistent hæmorrhage occurring from a deep vein after the employment of pressure and elevation, the vessel must be cut down upon and ligatured. When a large vein is pricked, and bleeds, the margins of the opening in the vein may be seized with a forceps, and tied with catgut; a larger opening, even in the inferior cava, has several times been closed by suture, or by clamp forceps left on twelve to twenty-four hours.

8. **Air in Veins.**—*See* VEINS, Entrance of Air into.

9. **Parasites.**—The embryos of the Tænia and the Bilharzia hæmatobia are occasionally found in the blood of the portal vein; the latter are also found in the veins of the bladder. *See* ENTOZOA.

10. **New-Growths.** — Tumours do not originate in connexion with veins, but they often compress veins or grow into their lumina, and their cells are disseminated by the passing current. Often these protrusions cause thrombosis, local or spreading. For an account of venous nævi, *see* TUMOURS: Angiomata.

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VEINS, Entrance of Air into.—SYNON.: Fr. *Aërhémoctonie*; Ger. *Lufteintritt in die Venen.*

The fact that animals could be killed by injection of air into the veins had been known since the middle of the seventeenth century, but the first case of spontaneous entry of air in man was not recorded till 1707, by Merz. After that time numerous observations were made on animals by Nysten, Bichat, Magendie, and others, in order to ascertain the cause of death, and the conditions under which it occurred. In the present century the subject has been investigated by Amussat, Erichsen, Pirogoff, Bouillaud, Brek, Panum, Fischer, and many others.

Anatomical Characters. — The air is found in the right auricle, often greatly distending it. In the whole right side of the heart it is usual to find a frothy mixture of blood and air. Bubbles of air are also found in the pulmonary artery, even in some cases in the smaller subdivisions.

Pathology.—The result of the investigations respecting the entrance of air into veins may be summed up briefly as follows:—

1. **Amount of Air necessary to Cause Death.**—This varies with the size of the animal experimented on, and the mode of injection of the air. A small animal requires a smaller amount of air to cause death than a large one. If slowly injected, enormous quantities may be pumped into the veins with impunity; while a quantity sufficient to fill the auricle, injected suddenly, is certainly fatal. Recovery may take place after the occurrence of very serious symptoms, and on the other hand death may occur after an interval of some hours or even days.

2. **Causes of the Spontaneous Entry of Air into a Wounded Vein.**—In inspiration, the diminished pressure within the thorax causes just the same tendency for the blood in the large veins at the root of the neck and the axilla to rush into the right auricle, as there is for the air to enter the lungs by the trachea. This aspiratory force does not extend beyond the veins mentioned, and the region in which they lie is often called 'the dangerous region.' If the vein be completely divided, its lax walls fall together, and thus offer a valve-like resistance to the entrance of air; but if in any way the opening be kept patent, air will rush in at each inspiration. The opening may be kept patent by a diseased condition of the walls of the vein, as when it passes through a tumour, or is embedded in inflammatory products; or the surgeon may pull open a half-divided vein by traction on the parts he may be removing; or the aperture may be circular, as when a small piece is cut out of the wall of the vein, or a branch is cut off close to the main trunk. The external jugular, if divided low in the neck, remains open, on account of its connexion with the cervical fascia. Gas formed in the uterus, as the result of decomposition of clots left in its cavity after labour, is said in some rare cases to have got up sufficient pressure to force its way in at the open mouths of the placental veins, and thus cause death.

Symptoms.—As the air enters the opening, it gives rise to a noise variously described as hissing, whistling, or lapping. If the patient be not under the influence of an anæsthetic, he cries out that he is dying, or makes use of some expression indicative of great distress. He becomes immediately pale and faint. There is intense anxiety, and the most severe dyspnœa. The dyspnœa is purely cardiac in origin, the air entering the lungs freely, with violent and hurried inspirations. The sense of want of breath is due to an interruption of the flow of blood through the lungs. The pupils are usually widely dilated. Although the patient is pale and faint, the action of the heart may at first be felt through the chest-walls to be violent and irregular, and it is said that on auscultation a peculiar churning sound may be heard. The pulse rapidly becomes weak. Convulsions have occurred in some cases, of a tetanic character; in some instances violent coughing has also been noted. If a large quantity of air has entered, death may be almost instantaneous. If a small quantity only has been sucked in, the patient may recover, occasionally after some hours or days of distress; and occasionally a fatal termination may take place a considerable time after the accident. Greene (*Amer. Journ. of the Med. Sciences*, xciii. p. 38) has collected 68 cases. Amongst these 24 died almost immediately; others died from three hours to seven days after the accident. In the cases that survived some days bronchitis supervened, and possibly the entrance of air may not have been the real cause of death.

There can be no doubt that death results from arrest of the pulmonary circulation. It is not from paralysis of the heart, as some have said, for the cardiac action continues long after the air has entered. The heart is constructed to pump onwards a fluid which, like all other fluids, is incompressible. If the right ventricle be filled with air, or a frothy mixture of air and blood, a considerable part of the force of its contraction will be wasted in merely compressing the air instead of driving it on. This, however, is but a small factor in the arrest of the circulation; the chief cause being that the air, or frothy mixture of blood and air, fails to work the valves. For the pulmonary valves to act, it is necessary that the artery should be filled and its coats stretched; but here we have the vessel only partly filled, and that with an elastic gas instead of an incompressible fluid. Its coats are but slightly stretched, and the valves probably lie flat against them, and are not closed by the current of air or froth regurgitating after the ventricular contraction has ceased. The tricuspid valve probably also fails to act. The want of blood in the lungs causes the sense of dyspnœa; and the flow through the lungs having ceased, the left side of the heart will become empty, and, no blood reaching the brain, faintness, followed quickly by death, naturally occurs. Supposing the patient to recover, the air which may have got into the circulation is absorbed by the blood.

Treatment.—The accidental entrance of air into the veins must be prevented by careful operating. If a vein can be seen to be in danger it is advisable to compress it on the proximal side. If it is necessary to divide it, a double ligature must first be applied. If the symptoms described should appear, a finger must be at once placed upon the wounded vein. The indications then are: (1) To get the air out of the auricle; (2) To fill the auricle with blood; (3) To keep up a supply of blood to the brain. To empty the auricle, the finger must be kept on the opening in the vein during inspiration, but removed during expiration, and at the same time the chest should be forcibly compressed. By these means frothy blood and air may be made to escape in considerable quantities from the opening. This is recorded as having occurred during the violent expiratory efforts of coughing that sometimes accompany this accident. To try to suck out the air by means of a tube inserted (as has been recommended) into the right jugular vein, would probably only ensure the patient's death. The auricle may be filled with blood by applying friction to the limbs in an upward direction. In order to ensure the flow to the brain of what little blood may be leaving the left side of the heart, it has been recommended to compress the abdominal aorta and the subclavian arteries. The veins being uncompressed can empty themselves into the auricle, which thus may be filled with sufficient blood to work the valves, and so restore the circulation. Should the respiration fail, it is advisable to try artificial respiration; but if the case reaches that stage, there can be but little hope of recovery, as it is not want of air in the lungs that causes death, but want of blood in the pulmonary vessels. Those who are interested in the subject will find references to the literature in Fischer's lecture, 'Ueber die Gefahren des Lufteintritts in die Venen während einer Operation,' *Volkmanns Sammlung klinischer Vorträge*, Series iv. No. 113.

Marcus Beck.

VENEREAL DISEASES.—A common term for all forms of contagious disease usually contracted and transmitted by impure sexual intercourse. There are three principal kinds of venereal disease: namely, *gonorrhœa*, *syphilis*, and the *local venereal sore*, or *chancre*. *See* Gonorrhœa; Syphilis; and Venereal Sore.

VENEREAL SORE.—Synon.: Local, Soft, Non-infecting Chancre or Sore; Fr. *Chancre Mou*; Ger. *Weicher Schanker*. The ambiguous term 'chancroid,' has been adopted by many American authors.

Definition.—A virulent, local, contagious ulcer, communicable by contact of its pus with a breach of surface.

Ætiology.—The ætiology of the local chancre is still a subject of dispute. Those who are known as *unicists* maintain that it is connected with syphilis. Others believe that it may be caused by the products of simple inflammation. But although the nature of the contagium is not yet established, the opinion which is most in accord with the present state of our knowledge on the subject is that the local chancre is due to a virus distinct from that of syphilis; that it never gives rise to any special constitutional symptoms; and that its effects are limited to the neighbourhood of the sore itself, and the nearest lymphatic glands.

Contagion.—The local chancre, like syphilis, may be communicated by direct or by mediate contagion; but it is of course never transmitted by inheritance. Syphilis is not infrequently conveyed in various ways independent of sexual intercourse (*see* Syphilis). The local chancre, on the other hand, is very rarely other than a venereal disorder; chiefly because, not being part of a general disease, it does not give rise to contagious lesions on distant parts of the body.

This disease, like syphilis, may be conveyed from one person to a third, through the medium of one whose cutaneous or mucous surface happens to be intact, and who thus escapes inoculation. One attack of the local chancre, unlike syphilis, affords no protection for the future.

Description.—When chancrous pus is inoculated artificially, the puncture within twenty-four hours becomes surrounded by a faint red blush; on the second day the redness extends, and the site of inoculation becomes swollen. On the third day a vesicle appears, and rapidly becomes a pustule. About the fifth day the pustule bursts, leaving a circular ulcer with well-defined, sharply cut edges, surrounded by a pink areola. The surface of the ulcer is uneven and spongy; the discharge is pus of a dirty yellow colour; and as time goes on the borders may become irregular and undermined.

When due to venereal contagion, the local chancre usually comes under observation as an ulcer which resembles that produced by experimental inoculation more or less closely, according to the circumstances of the particular case. The vesicle or pustule is rarely seen in practice, and in some cases the surface of the ulcer is raised above the surrounding parts by the development of prominent granulations; hence the term 'fungating sore,' or *chancre végétante* of French writers.

The base of the local chancre is supple, unless inflammation be present, in which case there is more or less thickening of the surrounding parts. The discharge is readily and repeatedly auto-inoculable; hence a plurality of sores is very common.

The *seat* of chancre is nearly always the genital organs or their immediate neighbourhood. A primary sore on the body of the penis is much more likely to be syphilitic than local.

The *form* and *aspect* of the chancre vary in some degree according to its position. Thus in the furrow behind the glans penis, the sore may be elongated; about the frænum, in the folds of mucous membrane around the anus, and about the female genitals it is often fissure-like. Again, when exposed to the air and neglected, it may become covered by a scab. If chancrous pus gain entrance to a follicle (*follicular chancre*) the latter may become distended, and temporarily simulate a small abscess.

As regards *size*, chancres rarely exceed half an inch in diameter, unless two or more run together, in which case they form a large irregular ulcer. Such confluent chancres are more common in women.

Course, Duration, and Terminations.—When a typical chancre is allowed to run its course, it lasts from four to eight weeks. This course is divided into three stages: (1) an increasing, (2) a stationary, and (3) a healing stage. The length of each is liable to vary from many causes. Roughly speaking, however, it may be said that the first period, during which the sore sensibly increases in size, occupies from a week to a fortnight; that the second lasts about a fortnight; and that at the end of from three to five weeks the stage of repair is reached.

By appropriate treatment the duration can be greatly shortened, but it is also influenced by the position of the sore. Thus, at the orifice of the prepuce or urethra, the irritation of the urine retards healing, and phimosis acts in a similar manner. Chancres of the frænum, again, often continue to spread until they have perforated or destroyed it. In fact, the more mobile and exposed to irritation the part, and the greater the difficulty of keeping the dressings in place, the longer will be the duration of the sore.

If the syphilitic poison have been inoculated as well as chancrous pus, the course of events will remain uninfluenced until the incubation-period of syphilis has elapsed; when, if the sore be still unhealed, it will gradually change in appearance by the development of induration at its base, until finally it assumes the characters of the initial manifestation (*see* Syphilis). If, on the other hand, the local sore has healed before the end of the period of incubation proper to syphilis, the scar will become indurated, and erosion or ulceration will probably, though not necessarily, follow.

Complications.—The less serious complications of the local chancre include *inflammation*, *phimosis*, and *paraphimosis*. These do not call for description here.

Phagedæna.—This graver complication of chancre may be either acute or chronic; and may attack the original sore, or the consecutive bubo, or both.

In a typical case of *acute sloughing phagedæna* the patient is usually much depressed. He soon becomes feverish, with a dry, brown tongue, quick pulse, and other signs of constitutional disturbance. The discharge from the sore diminishes; and is thin, sanious and shreddy, and very offensive. The margins of the ulcer are puffy and livid at first, but soon become black and ragged, presenting a 'gnawed' appearance. As the process goes on, the dead tissues separate in sloughs, which vary in size according to the rapidity of the destruction. In the worst cases necrosis is very rapid, and attended by severe pain. The whole of the genital organs in either sex may thus be destroyed; while, if the groin be the seat of phagedæna, the great vessels and nerves are quickly exposed at the bottom of a deep ragged cavity. If the process be not soon checked, death may occur from hæmorrhage, from exhaustion, or from some acute intercurrent inflammation.

The above description applies to a form of phagedæna which is now fortunately rare; but less severe examples, ranging in various degrees between that described and those where a sore simply becomes inclined to spread, looks unhealthy, and has 'gnawed' edges, are common enough in venereal practice.

In the *chronic form* of phagedæna the morbid process is much less active, and is not usually attended by much pain or constitutional disturbance. The sore spreads gradually, but the tendency is rather to extend widely and superficially than deeply. The groin is the most usual seat of the ulceration, whence it may extend upwards along the abdominal wall or down the thigh, laying bare the deep fascia, and dissecting out the superficial vessels and nerves. It often also undermines the skin extensively before destroying it; hence the loose and irregular margins of the ulcer are detached from the deeper parts for a considerable distance. The duration of this form of ulceration is very variable. It sometimes lasts for years; at one time appearing to be stationary, while at other times it spreads in one direction and heals in another. In such cases the patient's health suffers more or less severely, and finally he may become exhausted by the constant and prolonged irritation and discharge. If he recover, he may be permanently crippled by the contraction of the resulting cicatrices.

Bubo.—This complication, which is much less frequent in women than in men, is said to occur in about one-third of the total number of cases of chancre. Buboes may be either *simple* or *virulent*, the former being most common.

Simple or *sympathetic bubo* arises from ordinary irritation, and is similar to that caused by simple irritation of any other kind.

Virulent (*chancrous*) *bubo* may be due to the inoculation of a simple one by chancrous pus, or to matter conveyed from the sore by the lymphatics to the gland.

Bubon d'emblée. — This term has been applied to a variety of bubo, believed by some authors to result from the absorption of chancrous pus without the production of any lesion at the point of inoculation. The existence of such a bubo is not established beyond doubt. *See* BUBO, VENEREAL.

Lymphangitis.—This, like bubo, may be simple or virulent, but is a less frequent complication of the local chancre. Bubo of either kind may, and frequently does, exist without any perceptible change in the lymphatics leading to it; but when the vessels are affected, the glands are usually inflamed also. The thickened lymphatics can be felt as tender and often irregular cords, and their course is generally marked out by red streaks along the surface.

Simple lymphangitis may end in resolution, or one or more abscesses may form along the course of the vessel. The virulent form probably always goes on to suppuration, and the resulting sores become chancres in every respect similar to the original one.

DIAGNOSIS.—The local chancre is recognised by the characters which have been already mentioned, and which are recapitulated in the following table, where also they are contrasted with those of the initial manifestation of syphilis.

Local Chancre.	*Initial Manifestation of Syphilis.*
1. A local and nearly always venereal disorder, produced by the pus of a similar ulcer.	1. The first sign of a general and not necessarily venereal disease; it may be produced by the secretion of any syphilitic lesion, or by the blood during the earlier stages of the disease.
2. No period of incubation. Irritation begins within a few hours after contagion.	2. Always a period of incubation, which averages 24 days.
3. Begins as a pustule which soon bursts, leaving an excavated ulcer with sharply cut, loose, often undermined edges, and an irregular spongy floor of a dirty yellow colour.	3. Begins as a slightly elevated papule. Ulceration may be absent throughout. Edges raised, adherent, and rounded. Surface smooth and often of a ham-red colour.
4. Base supple unless inflamed, in which case it becomes firm like that of a boil; the firmness is diffused, resistant to the touch, ill-defined, and fades gradually into the surrounding tissues.	4. Base more or less indurated. The hardness is sharply circumscribed, somewhat elastic to the touch, and independent of acute inflammatory action; it varies much in amount, being sometimes superficial and scanty, and feeling like a thin layer of parchment or paper; sometimes abundant, and feeling like a mass of cartilage.
5. Discharge abundant, purulent, and freely inoculable through many generations, on the bearer as well as on others.	5. Discharge scanty, serous, and not readily auto-inoculable.
6. Inoculability on certain animals possible.	6. Inoculability on animals doubtful.
7. Usually multiple.	7. Usually single.
8. Very rarely seen far away from the genital organs.	8. Not very infrequent on the lip or finger, and on the breast in women.
9. Course acute, and often attended by pain or soreness.	9. Course chronic. Pain generally absent.
10. Duration greatly influenced by local treatment.	10. Duration usually depends on general specific treatment.
11. Inflammation and phagedæna not very uncommon.	11. Inflammation and phagedæna rare.
12. Glands remain unaffected or become acutely inflamed. Suppuration common. Bubo may be simple or virulent. Only one or two glands suffer.	12. Adenopathy constant, indolent, and generally multiple. Suppuration rare.
13. Never causes general infection of the system.	13. Is followed by constitutional symptoms.
14. Repeated attacks common.	14. A second attack rare.

While the characters given in the foregoing table are amply sufficient for the diagnosis of the two lesions in uncomplicated cases, it must be mentioned that the appearance of either sore may be altered in various ways, for example, by neglect of cleanliness, or by the application of irritants. Thus the local chancre, especially about the margin of the prepuce, may develop an amount of inflammatory thickening which cannot for a time be distinguished from that produced by similar causes in the syphilitic initial lesion; for the specific induration may become masked by inflammation. In such cases a positive diagnosis must be postponed until the irritation has subsided. Again, even if a patient present himself with a typical local chancre, it is of course not certain that the syphilitic poison has not been imbibed as well; and the incubation-period of syphilis must be allowed to elapse before the patient can be assured that his trouble is only local. Further, as regards the two most characteristic signs of primary syphilis, namely, induration of the base of the sore, and indolent multiple enlargement of the nearest lymphatic glands, one or other may be ill-marked, or in rare instances even absent, or at least inappreciable. Then, as regards number—the initial lesion of syphilis may be multiple if several places happen to be inoculated, as in the case of herpes for example; and the local chancre may be single, especially in persons of careful and cleanly habits. Inflammatory action also may mask the usually separate indolent glands of syphilis; but, apart from this, sometimes only one or two glands can be felt in the groins. This is most often the case when the glands have been spoiled by previous inflammation. Absence of enlargement also appears to be sometimes due to the pressure of a truss. In very fat people, again, the glands cannot always be felt.

Thus, in making a diagnosis, not one but all of the signs that may be present, together with the history of the case, must be taken into consideration; and if the diagnosis still remains doubtful, the case must be watched until conclusive evidence is forthcoming.

Auto-inoculation is sometimes of service in diagnosis, but in the present instance would not be of much value; for even if a typical local chancre were the result, syphilis could not be excluded until the incubation-period had elapsed. Care is always necessary in interpreting the results of inoculation; for though it may be reasonably concluded that an active sore the discharge from which is not auto-inoculable is not a local chancre, yet the converse by no means always holds good. It must be remembered that matter from various lesions, under certain conditions, becomes inoculable on the bearer. The important point is not that inoculation produces something, but the character of the lesion which it produces.

When an immediate diagnosis is imperative, *confrontation*, or comparison of the patient with the source of his disease, may set the question at rest; but many precautions are necessary in drawing conclusions from such evidence.

Ulcerating syphilides, especially mucous patches of the female genitals, occasionally resemble chancres, but the presence or history of other signs of syphilis would lead to a correct diagnosis.

Gummata about the genital region, in both sexes, after breaking down, leave ulcers which sometimes resemble local chancres, but which as a rule are not auto-inoculable.

Besides syphilitic affections, there are a few others which require to be mentioned in connexion with the diagnosis of the local chancre. *Herpes* is characterised by vesicles or small superficial erosions on an inflamed area. Itching or smarting also often precedes an attack of herpes, and there is frequently a history of previous attacks, which, again, are often independent of any suspicious sexual exposure, and are liable to recur at regular intervals, or in connexion with digestive disturbance. Herpes also usually disappears in a few days under measures of simple cleanliness.

Abrasions are irregular in form, are usually noticed by the patient at the time of their production or very soon afterwards, and heal readily in a few days if they are not irritated. Both herpes and abrasions, however, as well as the erosions due to balanoposthitis, may, under irritation of various kinds, become suppurating and inflamed ulcers, which for a time it is difficult to distinguish from chancres.

When phimosis prevents exposure of the parts, a discharge from beneath the prepuce may be due to several other causes besides the local chancre, for example, syphilis, gonorrhœa, balanitis, or warts. If the local chancre be present, its site is usually indicated by the presence of a tender spot in that situation, and pressure often causes a slight oozing of blood. Consecutive sores also quickly appear at the margin of the prepuce. In the case of *syphilis*, the presence of induration, and the multiple indolent enlargement of the inguinal glands, will usually render the diagnosis clear. In *gonorrhœa*, soreness of the deeper urethra, scalding during micturition, the presence of chordee and other signs of urethritis, and the absence of localised tenderness beneath the swollen prepuce, are points that will usually determine the nature of the case. In *balanitis* there will be an absence of circumscribed tenderness and of signs of urethritis. *Warts* can be felt through the prepuce, and a portion of the growth can usually be seen by putting the parts on the stretch. A small speculum is sometimes of use for diagnostic purposes in cases of phimosis.

PROGNOSIS.—The prognosis of the uncomplicated chancre is always favourable. If any complication arise, the prognosis will depend upon its nature and severity.

TREATMENT.—The treatment of chancre consists chiefly in the employment of local remedies. The general treatment at the same time is directed, on ordinary principles, to the maintenance of the patient's health, by tonics, regulation of the diet, moderation in, or abstinence from, alcohol, and as much rest as possible, in order to diminish the risk of complications.

A local chancre of only a few days' duration can generally be destroyed by one thorough application of heat or caustic. The advantages of such a mode of procedure are that (*a*) consecutive inoculation, and consequently multiplicity of sores, is prevented; (*b*) the risk of bubo and of other complications is diminished; and (*c*) the duration is shortened.

When the surface is large, or when the sores are numerous, destructive measures should only be employed when milder ones have failed.

The thermo-cautery is the most convenient form of actual cautery; but for small sores, caustics usually suffice, and are less alarming to the patient; strong nitric acid, and the mixture of charcoal and sulphuric acid commonly known as 'Ricord's paste,' are the most suitable forms. Nitrate of silver should not be used for this purpose, because, while probably not strong enough to destroy the virus, it causes pain and irritation, as well as inflammatory hardness, which is sometimes sufficiently extensive to interfere with the diagnosis of the case. Before using either caustic or cautery the following points should be borne in mind: (1) No sore should ever be cauterised unless *the whole* of the diseased surface can be acted on. (2) The surrounding parts must be thoroughly cleansed and disinfected.

From a purely therapeutic point of view, however, destructive measures are at the present time not often required; and as regards the prevention of syphilis, supposing the virus of that disease to have been inoculated, the results of observation so far seem to give but little hope of success.

In nearly all cases the best application is iodoform, of which the *powdered* crystals may be sprinkled on the sore by means of a quill, or applied with a moistened camel's-hair brush twice or thrice daily, according to the amount of discharge. The sore should then be covered with a piece of lint or wool, and if the dressing cannot be kept in place by the natural conformation of the parts, a narrow strip of bandage or plaster should be applied. Iodoform may also be applied as an ointment with vaseline, or with glycerine, or an ethereal solution may be painted on the part, a thin coating of iodoform being left after the evaporation of the ether.

If iodoform is not used, powdered boric acid, or salol, or a lotion of carbolic acid, sulphate of zinc, or lead, may be applied, according to the state of the ulcer. Whatever dressing is employed, care must be taken to change it frequently, to prevent the urine from coming in contact with it, and to arrange it so that opposed surfaces are kept apart. Chancres with phimosis must be treated by frequent injections, with a syringe having a long nozzle, of a lotion of carbolic acid (1 in 40), or of boric acid and glycerine. Any of the sores that are within reach should be dressed with iodoform, and a piece of absorbent wool placed within the preputial orifice.

Treatment of Complications.—Inflamed chancres should be treated by keeping the patient at rest, on simple diet; by the administration of a purge; and by the application of lead and opium lotion or some other soothing dressing. In phimosis, if the swelling is so great as to prevent the use of the syringe, or if sloughing is threatened, the prepuce must be slit up or removed altogether, and the case treated according to the directions given for the treatment of phagedæna.

If in paraphimosis the prepuce be naturally too narrow, or if strangulation occur, reduction should be effected.

Phagedæna.—On the first appearance of signs of acute phagedæna, the affected part should be immersed for nine or ten hours a day in water at a temperature of about 98° F. This can be easily accomplished by keeping the patient in a hip bath, and alternately adding and removing small quantities of water, so that the requisite temperature is maintained. Care must of course be taken to protect the patient from cold, by placing the bath in a warm room, and by wrapping the exposed parts of the body in blankets. This plan succeeded well at the Male Lock Hospital;[1] and if it be adopted at an early period the sore often becomes healthy in a few days; immersion, however, should always be continued for at least a day or two after this has occurred, to guard against relapse. The patient may generally be allowed to go to bed during the night, iodoform or some other suitable dressing being applied; but if the diseased action continue to extend, the duration of the bath must be prolonged, or even be made continuous; but in that case, as well as in the cases where the groin is the seat of the disease, a full-sized bath in which the patient can lie down will be necessary. In all cases the whole of the diseased surface must be fully exposed and thoroughly submerged.

If iodoform and immersion fail, or if immersion cannot be properly carried out, a lotion of tartarated iron (10 to 60 grains to the ounce) with extract of opium, or a saturated solution of permanganate of potassium, should be tried.

If milder measures fail to arrest the phagedænic action, the sore may be cauterised. If the surface is large, the actual cautery will be more likely to succeed than chemical agents.

Hæmorrhage from a phagedænic sore should always be checked as soon as possible. If the bleeding is slight the surface should be cleaned, and pellets of cotton wool, soaked in solution of persulphate of iron, pressed on each bleeding spot, and retained in position by a bandage applied as tightly as the patient can bear. In severe cases the actual cautery may be necessary; and in extreme instances ligature of the larger arterial trunks above the seat of disease may be required.

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[1] See *Lancet*, May 24, 1879.

The general treatment of phagedæna consists in the administration of good food, tonics, and opium in sufficient quantity to relieve pain, but under the immersion plan of treatment pain usually quickly ceases, and little or no opium is required. Fresh air and good ventilation are also most important.

The treatment of chronic phagedæna is similar to that of the acute form, but of course more time is allowed for the trial of palliative measures before having recourse to the cautery.

For the treatment of simple bubo, *see* BUBO, VENEREAL.

The management of the *virulent bubo*, after evacuation of the pus, differs in no respect from that of the local chancre, which has been described; and the treatment already recommended for phagedæna applies equally to that morbid process, as a complication of the local chancre, of bubo, or of syphilitic ulcers, whether primary, secondary, or tertiary; but in the case of syphilis the administration of mercury or iodine or both, according to circumstances, forms an important element in the management. In fact, in every case of obstinate phagedæna, especially of the chronic form, most careful search should be made for signs or a history of syphilis; for, if that taint be present, it not infrequently happens that all local applications fail until the constitutional malady is attacked.

ARTHUR COOPER.

VENESECTION (*vena*, a vein; and *secto*, I cut).—SYNON.: Bleeding; Blood-letting.—Abstraction of blood by opening a vein. *See* BLOOD, Abstraction of.

VENOM, Effects of: VENOMOUS ANIMALS.—SYNON.: Fr. *Animaux Vénéneux*; Ger. *Giftige Thiere.*

DEFINITION.—Animals which possess the power of secreting and ejecting a poison, which, when inoculated in man or other animals, produces toxic or even fatal effects.

Venomous animals are found in many classes of the animal kingdom.

1. Reptilia.—Reptilia furnish the most numerous and important kinds of venomous animals, and these are limited almost entirely to the order *Ophidia* or snakes.

The statement that no *lizard* is poisonous, is not strictly correct. The heloderm (*Heloderma suspectum*) of Mexico possesses venomous properties, destructive to small animals, and injurious to man himself.

DESCRIPTION.—The poison-apparatus of a snake consists of a composite racemose gland, situated in the temporal region, secreting a clear, slightly viscid fluid, which is poured through a duct into a grooved fang situated on a movable maxillary bone.

The fangs are longer, more curved, more movable, and more formidable in viperine than in colubrine snakes.

Snake-poison is very deadly; more active in some snakes, quantity for quantity, than in others; and varying in activity in the same species or individual, according to season, temperature, and state of health. It acts most rapidly when injected into the blood; but it can be absorbed through mucous and serous membranes, as seen by its poisonous effects when applied to the conjunctiva, the stomach, and the peritoneum. It may neither be applied to the lips nor taken into the stomach with impunity; and sucking a snake-bite is by no means free from danger, though if the saliva be quickly ejected and the mouth washed, the danger is probably small. It may be noted here that the poison of viperine forms differs considerably from the colubrine. They both contain active principles, two of which, according to Drs. Weir Mitchell and Reichert, are proteids, one belonging to globulins, the other to proteins; they attribute the difference of the physiological effects produced by different species to the varying proportions of these bodies. Analysis has shown the poison to be very nearly like albumen in composition. It is most active on warm-blooded creatures. Poisonous snakes are very insensible to the venom of other poisonous snakes, and absolutely so to that of their own species.

EFFECTS.—The action of the poison is *local* and *general.*

The *local* effects of snake-bite comprise pain; partial paralysis of the bitten part; ecchymosis; swelling; and, if death does not rapidly follow, infiltration of other and distant parts, cellulitis, and sloughing.

Associated with these local effects are many severe *general* phenomena, such as depression, fainting, nausea, hurried respiration, vomiting, exhaustion, hæmorrhagic discharges, lethargy, loss of coördinating power, paralysis, loss of consciousness, relaxation of sphincters, coma, and convulsions. If the quantity of poison injected be small or its nature feeble, the earlier symptoms may give way, and recovery take place.

Snake-poison acts by paralysing the nerve-centres, or sometimes the peripheral distribution of the nerves; and by altering the constitution of the blood. It takes effect through the circulation; and if inserted into a large vessel, such as the jugular, humeral, axillary or other large vein, it will cause almost instant death, the heart's action stopping in systolic spasm. The respiratory centres, the spinal cord, the peripheral nerve-distribution, may all be affected. In ordinary cases death seems to take place by arrest of the respiration, the heart's action continuing for some time after apparent death. The muscular fibre itself would appear in some cases to have its contractility impaired or destroyed. The poison also acts septically, producing at a later period sloughing and hæmorrhage.

There are certain points of difference in the action of viperine and colubrine venom. In the former there is greater tendency to hæmorrhage, extravasation, and fluidity of the blood; in the latter, the effect seems to be more directly upon the nervous system, the blood being less affected than in the viperine. Experiments on animals show that, generally, after death from cobra-poisoning the blood coagulates firmly, whilst after death from viper-poisoning the blood remains permanently fluid. In most cases of death in man the blood has been found fluid even after cobra-poisoning.

Prognosis.—In cases of moderate severity, remedies, with careful nursing and tending, may prove successful; but where the bite has been thoroughly effected by the ophiophagus, cobra, daboia, echis, rattlesnake, craspedocephalus, cerastes, and others, the prognosis is very unfavourable; in no case, however, should efforts be relaxed until the last.

There is often uncertainty as to the kind of snake, its condition, and the extent to which its fangs were used. The great shock or depression which follows a snake-bite may be in a measure due to fright, and will, on reassurance, pass away. The marks of two well-defined punctures attest the insertion of two fangs, and, if the snake has not been seen, may enable one to form an opinion as to its character. Many of the innocuous snakes are fierce, and bite vigorously, but their numerous teeth leave different marks from those of the poison-fangs. There are exceptions to this rule, however; a few innocent snakes have the anterior maxillary teeth developed like poison-fangs, but bites from them are not very likely to occur.

It may be well to note some of the characters that distinguish the venomous snakes, such as the form and arrangement of the teeth; an examination of the wound will often reveal the true character of the bite, and serve to indicate a correct prognosis. On opening the mouth of a venomous colubrine snake, such as *naja* or *bungarus*, two slightly movable fangs will be observed, one on either side, as well as several loose reserve fangs in various stages of development; and close behind them there may be seen one or two smaller teeth. There is no row of teeth along the outer side of the mouth, but a double row of palatine teeth will be found on either side. In the viperine and crotaline snakes, a large fang only is found on either side, and a palatine row as in the colubrine. There are no small fixed teeth behind the fangs as in colubrines, but in a fold of mucous membrane at the base of the fangs, both in vipers and colubrines, several loose reserve fangs will be found in various stages of development, one of which takes the place of the ordinary fang when it is shed, by becoming ankylosed to the maxillary bone. In *hydrophidæ* the fangs are arranged like those of the cobra, but are very minute, and no reliance can be placed on any mark made by them. The circumstances under which a bite is inflicted will generally help to indicate the kind of snake.

Harmless snakes have a double row of equal or nearly equal-sized teeth in the maxillary and palatine bones. But, as before stated, there are certain innocent snakes that have long anterior maxillary teeth, which might cause doubt as to the nature of the bite.

Treatment.—There is reason to believe that the numerous agents that have been recommended from the earliest times as antidotes of snake-poison are useless, and have no such properties as those ascribed to them.

The rational treatment of snake-poisoning is to endeavour to prevent the entry of the virus into the circulation; to neutralise it in the wound before it is absorbed; to support the failing nervous force if it have entered; and to favour its elimination.

The application of a tight ligature between the bite and the heart, and the immediate excision or destruction of the bitten spot, by cautery or caustic, are essential; and other local measures may appear necessary. The injection of a 5 to 10 per cent. solution of permanganate of potassium into the bitten part has for its object the neutralising of the poison retained there by the ligature, and there is reason to believe that this is sometimes effected. The ligature may then be removed, thus obviating the risk of gangrene in the part below the constriction.

The constitutional treatment requires that the strength should be supported by stimulants, such as alcohol and ammonia. Next, if the respiration be failing, artificial respiration should be resorted to. Elimination should be promoted by stimulating diuretics. The patient should be kept warm; and must not exhaust himself by walking about. Ammonia has always held a high place among remedies in snake-poisoning. Its injection into the veins has been warmly advocated in Australia, and is said to have met with success there, which it certainly had not in India.

Dr. Mueller in Australia strongly advocates the injection of strychnine in repeated doses, and cases are cited which seem to confirm its utility; but there is not yet sufficient evidence to warrant the certainty of its efficacy.

2. **Amphibia.**—None of the amphibia are known to possess a poison-apparatus like that of ophidia; but toads and salamanders secrete a fluid in glands along the back,

connected with the integument, which yields an actively venomous principle, capable of causing local irritation, and, when injected into the blood, death, preceded by symptoms indicating action on the cerebro-spinal nerve-centres. Dogs seizing the toad, *Bufo vulgaris*, are known to suffer from swelling of the lips and salivation; and a case of death was related in France, in 1865, of a child in whom an abrasion of the hand came in contact with the secretion of a toad; death was preceded by vertigo, vomiting, and fainting. When this poison is injected into guinea-pigs, small birds, and other animals, violent symptoms and death soon follow. It is a viscid, milky fluid, with a slightly yellow tint and peculiar odour; it is exuded, and may be pressed, from glands behind the orbits. Zalesky has shown that the land and water salamanders, *S. maculatus* and *Triton cristatus*, and probably others, have also the power of secreting venom; and his experiments prove that it contains a very active principle—*salamandrine*—and that its action on the cerebro-spinal nerve-centres is energetic. It appears that these poisons, like those of ophidia, though effective on others, have no action on their own species.

3. **Pisces.**—DESCRIPTION.—Several fishes are provided with an apparatus consisting of a cavity at the base of, or a sac and duct leading to, a channelled spine, through which an irritating secretion is ejected. No true poison-gland, however, has as yet been certainly made out. This secretion is apparently connected with the secreting mucous system; and in certain species it produces marked symptoms of poisoning, though never to the same extent as in venomous snakes. Fish armed with sharp or serrated opercular or fin spines can inflict severe injuries, liable to cause great pain, and to be followed by the grave symptoms attributable to the lacerated or punctured nature of the wounds; and these may be aggravated by the irritating nature of the mucus with which they are contaminated. In several, however, in addition to the spine, there is a distinct receptacle in connexion with it, either in the form of a sac or duct such as in the *thalassophryne*, or in a cavity in the spine itself, as in the *trachinus* or weever.

In the case of others, such as the sting-rays, which may produce severe wounds by their pointed and serrated spines, there is no distinct receptacle for the poisons in connexion with them. Whilst it is well known that many spiny fish are capable of inflicting wounds that are dangerous from their lacerated and punctured character, it is recognised that others increase the danger by the inoculation of an irritating fluid, as just stated.

EFFECTS.—The effect of fish-poison is to produce severe burning pain at and beyond the injured part, and fever. The intensity, no doubt, depends upon the quantity of poison injected, and the state of health and constitution of the person at the time. The wound alone, even without the poison, is likely to be painful and severe from its punctured character.

TREATMENT.—Ipecacuanha, tobacco, alkalis, alum, and ammonia have all been recommended as useful local applications to allay the irritating action of such poisons. Poultices of onions, or warm applications of opium or other sedative fomentations, are likely to be useful; and prompt surgical relief, if suppuration or cellulitis occurs, is necessary to relieve tension, to evacuate pus, or give exit to sloughs.

The constitutional treatment is such as would be indicated by the condition and progress of any other inflamed punctured wound. In case of depression of the heart's action, alcohol or ammonia would be indicated. Rest, quiet, and due attention to the state of the bowels, and elimination by the skin and kidneys, with careful regulation of the diet, should be observed. *See* POST-MORTEM WOUNDS.

4. **Mollusca.**—*Aphysia punctata*, the sea-hare, a gasteropod, is said by some to produce an irritating secretion capable of causing urtication and even severe inflammation, and of causing the hair to fall off.

5. **Arthropoda; Myriapoda**, family *Scolopendridæ.*—The centipedes possess mandibles, formed by a pair of dilated feet, joined at their origin, with perforated, hook-like points with an aperture near the apex, through which a poisonous fluid, secreted in a poison-gland, with sac and duct, is ejected when they bite, which they can severely. In the case of the larger tropical species the bite is sometimes very painful, and causes considerable local irritation, and even constitutional disturbance—fever and delirium. That of the smaller kind generally causes only local and transient irritation. Centipedes are found nearly all over the world, in Europe, Africa, America, the East and West Indies and Islands, and in the tropics generally. Those of warm climates are the largest and most dangerous.

6. **Arachnoidea.**—*Scorpionidæ* or *Pedipalps.*—DESCRIPTION.—Scorpions have a segmented abdomen, the last six joints of which are narrowed into a tail, terminated by a curved perforated spine or hook, with which they strike and wound. At its extremity are two small orifices, through which venom is injected from a gland-receptacle and duct at its base. Scorpions run about quickly, carrying the tail curved over the body. They live in holes in the ground, and under stones or logs of wood, in dark places. The tail is used as an offensive weapon. They seize small creatures with their palpi, and then pierce them with the sting. The venom is so active that it quickly destroys life in

these animals. Those of tropical climates are most active and poisonous. They attain to the length of from two to three, four, and six inches. The European genera are smaller and less active.

Scorpions exist in all tropical countries, but extend also into the warmer regions beyond the tropics. They are found in the East and West Indies, Ceylon, and other islands, Australia, Africa, Egypt, South of Europe, and America. There are several genera, and *Buthus afer*, *Androctonus*, and *Buthus Cæsar*, are good examples of the active kinds. *Europæus* and *Occitanus* are also venomous, but those of Europe are less active than the tropical forms.

Effects.—The effects of the sting of the scorpion and of the bite of the centipede have no doubt been exaggerated; but they may produce very painful, and in the case of the larger species, severe and serious symptoms, in their character not unlike, or even more severe than, those of the sting of the wasp, namely, pain, swelling, in some cases numbness, vertigo, nausea, vomiting, temporary loss of vision, swelling of the tongue, and fever. Death may occur in delicate or sickly subjects. The local and constitutional symptoms may be severe in persons of irritable constitution, or otherwise out of health; but generally in the case of bites of ordinary scorpions or centipedes inflicted on healthy subjects, the suffering is local and soon passes away.

Treatment.—A variety of remedies have been recommended for scorpion-poisoning. Probably the application of a ligature above the bitten part, or a cupping-glass, or suction of the wound, as in snake-bite, might be useful. Some authorities recommend that the wound should be scarified, and emollient ointments and poultices applied. Suction of the wound, and the application of salt water, vinegar, ammonia, alum, ipecacuanha, spirit of camphor, eau de Cologne, tobacco water, turpentine, tincture of iodine, alcohol, the leaves of cruciferous plants made into poultices, solutions of opium and lead, or other sedatives, will lessen pain and irritation. The use of diffusible stimulants, opiates, or other sedatives may be necessary, and such surgical interference as suppuration or cellulitis may require.

7. **Arachnida.** — Description. — Some spiders are venomous, and certain of the larger tropical forms are capable of inflicting painful bites. The poison-apparatus of spiders consist of falces or modified mandibles or jaws, the last joint of which is a hard curved fang, with a fissure near the point; there is an elongated poison-sac and duct in which the venom is elaborated and thence transmitted to the fang, by which it is inoculated into the flesh of its prey.

Effects.—The venom of spiders is a very cative principle, and apparently is capable of rapidly destroying the life of the small creatures on which the spider feeds. It also causes symptoms of poisoning in man and the lower animals. Probably all the species have some venomous secretion, but it is only the larger kinds that are obnoxious to man. It may be noted that whilst the fangs of one section of spiders move laterally, those of the Mygalidæ move vertically. There are several species. Those reputed venomous are tropical.

Lycosa tarantula is reputed to cause extraordinary symptoms. It is poisonous, but there is no reason to believe that its effects exceed a certain amount of local irritation. *See* Tarantism.

There are numerous families, genera, and species of spiders, all probably possessing an irritating fluid; but it is only in the larger kinds that they do so to any extent, and there is no very positive proof that even in tropical climates they inflict the grievous injuries ascribed to them, though the venom is very fatal to the creatures on which they prey.

The popular notions that the spider is very poisonous when swallowed, and that its web possesses medicinal properties, are probably exaggerated, if not altogether untrue. One species of red spider, however—perhaps a mite—called *coya*, in Popayan, is very poisonous; the juices of its body when crushed, coming into contact with the punctured skin, cause tumours, or even, it is said, death. This is no doubt an exaggeration, but it is probable that the juices are acrid and irritating, and it is therefore better not to crush these animals when detected on the person, but to brush or blow them away.

In India, a streak of almost erysipelatous redness of the skin coming on rapidly is often attributed to a spider. No one has defined the species; it is possible that it may be analogous to that just referred to.

Treatment.—The treatment of spider-bites is similar to that of centipedes and scorpions.

8. **Acarina.**—Description and Effects. Some mites have the power of causing considerable irritation by a secretion ejected on the surface, or injected into the wounds they make in their burrowing operations with claws or mouth.

The *Tetranychus autumnalis*, *Leptus autumnalis*, or Harvest Bug, is brick-red in colour, and very minute. It is bred on plants, but leaves them to fasten on animals, especially man, when it adheres firmly, and causes swelling, great irritation, and severe itching, if in numbers. The intense irritation causes fever. The symptoms are not unlike the sting of a nettle, erythema or even blistering being caused. The leptus is covered with hairs, and effects entrance into the skin with its claws, and thus gives rise to the great irritation, which is probably aggravated by some acrid excretion. These animals are found in Britain, France, and other parts of Europe; varieties of them in the tropics, for example, in Brazil, Honduras, on the Mosquito Coast, and in the West Indies. The *T. irritans* of the Mississippi valley causes great irritation in the same way.

Treatment.—The treatment is to extract the bug with a needle or the point of a knife, and then apply some soothing lotion.

Argas persicus, a gamosid, known also as the *Teigne de Miana*, venomous bug of Miana, is common in Persia. It is found in the houses, and it is said that its puncture produces serious symptoms, such as convulsions, delirium, and gangrene, or even death. This is an exaggeration, though probably it is true that local irritation, and perhaps some constitutional disturbance, may be caused. It is blood-red in colour, spotted with white on the back, the feet yellow. *Argas moubata*, a native of Angola, is said to have much the same properties.

The *Argas talaje* of Guatemala produces great irritation. It bites like an ordinary bug, and the punctures are followed by great irritation, swelling, and pain. It lives in holes in the bamboo walls, or such-like crevices, and issues at night to attack the sleepers.

9. **Hemiptera.**—Some of the *Geocorysæ* and *Hydrocorysæ*, or land and water bugs, have irritating properties, and also an offensive odour; they have a suctorial mouth, armed with a grooved instrument or rostrum for piercing the skin.

Cimex lectularius, the bed bug, causes much irritation, and in some persons inflammatory action in the bitten part. The effects are transient.

Notonecta and *Nepa*, common in pools of water in our islands, are also capable of inflicting a painful puncture. *Cimex nemorum* causes nearly as much pain by its puncture as the sting of a wasp. The wheel bug, *Reduvius serratus*, of the West Indies, gives an electric shock to the person it touches. St. Pierre mentions a species of bug in the Mauritius whose bite is as venomous as the sting of a scorpion. The *Benchucha*, or great black bug, of the pampas of South America, is more obnoxious, it is said, than the common bed bug.

10. **Aphaniptera.**—*Pulicidæ* or Fleas comprise several families. *Pulex irritans*, the common flea, is universal. It varies much in size and colour; some are almost black and very large, and are found on the sandy shores of the Mediterranean. There are many species, such as *P. canis*, *P. musculus*, *P. vespertitinus*, and others. *Pulex penetrans* of the West Indies and South America, known also as the jigger or chigoe, penetrates the skin, and beneath the nails, generally of the feet, causing great irritation. It will, if not extracted, deposit its ova, and thus give rise to severe irritation. The effects of the ordinary flea-bite are well known. Though the irritation of flea-bites is chiefly due to the wound, there is reason to believe that this is aggravated by the presence of some irritating secretion. No special treatment, beyond the application of ammonia, which may be useful, need be described.

11. **Diptera.**—Description and Effects. To this order belong the gnats, mosquitoes, pipsas, sand-flies, and gad-flies, all more or less dreaded for their bites. They have a proboscis composed of a grooved and flexible sheath, through which long, slender, sharp darts are protruded, that pierce the skin and inoculate some venomous secretion, though its nature is not known. They draw blood, and raise white lumps or swellings; some, such as the pipsa of the Cossiah Hills, India, leave a livid spot of effused blood, which gives to the sufferer the appearance of a purpuric rash. They swarm in many countries, generally near water. The principal forms are the *Culex pipiens*, *C. reptans*, *C. mosquito*, *C. laniger*, and the whame fly, *C. tabanus.* Some of these are formidable insects, and are insatiable blood-suckers. The *tsetze* or *timb*, *Glossina morsitans*, of Africa, is one of the most remarkable. The bite of this poisonous insect is almost certain death to the horse, ox, or dog; though it appears not to trouble man more than by causing slight irritation.

The female *Simulium*, or sand-fly, is irritating to man, the bite often giving rise to painful swellings. The pipsa is probably a simulium. It appears from the great irritation and the swelling that follows the puncture of most of these insects that some acrid secretion is injected into the wound. In young, full-blooded persons, especially recent arrivals in India or the tropics, the irritation caused by mosquito-bites is often so severe as to give rise to violent inflammatory symptoms, resulting in suppuration or ulceration, and even gangrene.

Treatment.—The application of common salt, solution of ammonia, soda, potash, lead, oil, ipecacuanha, or alum combined with opium, allays irritation in the first stage. The more violent inflammatory symptoms are amenable to ordinary surgical treatment. Camphor, pulegium, and lime-juice, applied to the skin, are all regarded as preventives.

12. **Hymenoptera.** — Description and Effects.—A number of species that secrete poison are found among the different families of hymenoptera, including bees, wasps, and ants. *See* Sting.

They are distinguished by the presence of an ovipositor in the female, which not only is used for depositing the eggs, but as a weapon for injecting venom. It consists of two valves as a sheath, and three bristles which form a grooved sting. Through this groove the poison is injected into the wound, the ovipositor being connected with a poison-gland at its base.

Formicidæ. — Ants include *Formica smaragdina* and many others. The sting of the ant causes considerable irritation, especially if there are many. It has been suggested that formic acid is the irritating principle. There are several venomous species of ants, black and red, of various sizes. Some of the larger forms in the tropics are capable of inflicting a very painful injury. Some ants have no sting, but eject a fluid which irritates the skin.

Vespidæ.—The females and workers of the wasps and hornets are provided with a poison-sac and sting. *Vespa vulgaris* is a type of the tribe *Crabro.* It lives in communities. Its sting produces much irritation, pain, and swelling, especially when inflicted on the face, or where the cellular tissue is loose.

Apidæ.—True bees, and the *Bombidæ* or humble bees, have similar properties, their sting producing very much the same effect as that of the wasp.

Some of the parasitic *Hymenoptera* inject a poison into the wound made by their ovipositor. The best-known instance is that of the genus *Ophion.* The genus *Paripla* also injects a poison in the same way, and probably others of the *Ichneumonidæ.*

Treatment.—Many remedies of a simple nature have been recommended to allay the pain and irritation caused by the sting of the wasp and bee, such as vinegar, eau de Luce, ammonia, tobacco juice, solution of soda or potash, oil, indigo, eau de Cologne, alum, and all those recommended in scorpion-stings. In case of venomous stings, where constitutional disturbance is induced, stimulants or sedatives may be necessary; and as the sting is liable to be left in the wound, it ought to be picked out. In cases of wasp or bee stings in the mouth or throat, which may happen when children bite a peach or other fruit that conceals a wasp, severe consequences may arise from the œdema that supervenes, and extends to the glottis. An emetic is then useful. With the ordinary treatment of œdema, laryngotomy may become necessary. In other cases, should violent symptoms supervene, surgical aid may be required to relieve tension, or give exit to matter. Such untoward results, however, are happily rare.

Mutilla coccinea, a native of the warmer parts of North America, is said to produce loss of consciousness within five minutes of the infliction of its sting, life being in danger for some days afterwards.

13. **Lepidoptera.**—The majority of insects furnished with a sting, as a means of defence, belong to the Hymenoptera. It is but recently that a stinging lepidopterous insect has been found. The species is not mentioned (F. Smith). The bee moth of the Cape of Good Hope is said to defend itself with a sting. Though the majority of the perfect insects of this tribe are harmless, some of the caterpillars appear to be possessed of irritating properties, residing in the fine hairs with which they are cased, and which, being sharp and brittle, break off and remain in the skin, causing irritation mechanically; but also probably from the presence of some acrid substance concealed within the hairs. In Ceylon, a greenish hairy caterpillar, longitudinally striped, probably of the genus *Bombyx,* which frequents the leaves of *Hibiscus populneus,* alighting on the skin, causes as much irritation as the sting of a nettle. The larva of *Neæra lepida* has similar properties. It is short and broad, of a pale green, with fleshy spines on the upper surface, each of which is charged with venom that occasions acute suffering. The larvæ of *Adolia* are also armed with venomous hairs. Another, not uncommon in certain trees in the terai of the Himalaya, is a dark-coloured hairy caterpillar, which is apt to fall on people and cause intense irritation. It is known as the *Komlah,* but the moth that produces it is not known.

14. **Coleoptera.**—Several beetles have acrid secretions capable of exciting great irritation and inflammation, raising blisters, and if absorbed causing painful strangury and great urinary irritation. Such are *Mylabris Cichorii* of India, *Cantharis* or *Lytta,* or *Meloe vesicatoria, Lytta gigas* of Senegal, *Lytta vitata* of America, and *Lytta ruficeps* of Chili.

15. **Echinodermata.**—The long sharp pointed spines of some of the echinids are capable of inflicting painful punctured wounds, but convey no true venom. Whether, as in the case of some spiny fishes, there may be an irritating mucous secretion inoculated is uncertain.

16. **Cœlenterata.**—Some of the *Medusæ* or jelly-fish have the power of stinging. The poison-apparatus is placed in certain tubercles on the surface. These contain a collection of granules, amongst which are small vesicles. Within these corpuscles or nematocysts a spiral thread is found, which bursts out on pressure. These corpuscles are found in the mucus exuded by the creature, and to them is attributed the urticating power it possesses. There are several stinging species, some found on our own coasts, others in other seas. It is the larger forms generally that are venomous, the small ones having no effect on man. *Cyanea capillata* of our seas is a rather formidable creature, and the terror of bathers. It has a broad tawny disk, and a long train of ribbon-like streamers floating after it; it makes its way through the waters; and whatever comes in contact with these trailing trains soon writhes in torture, the effect produced being not unlike that of the nettle.

Physalea pelagica, the Portuguese man-of-war, has similar properties. It causes severe and stinging pain, extending up the limb, with feverishness, which has been known to continue for some hours, white wheals forming on the skin, as in urticaria. Several other medusæ possess these properties, and hence they have received the name of Acalephæ, or sea-nettles. The application of vinegar or olive oil is said to remove the unpleasant symptoms.

The *Actiniæ*, or sea-anemones, and the hydroid polyps, appear to possess a similar power, and are provided also with thread-cells. They cause urtication of the human skin when brought in contact with their tentacles. The *Sagartiadæ* furnish examples of sea-anemones with this property. The effects, however, of any of them are transient. In some parts of Europe the *Acalephæ* have been used therapeutically as counter-irritants, by being brought in contact with the patient immersed in a salt-water bath.

In the preceding description the writer has not attempted to treat exhaustively the subject of venomous animals, or to describe all the forms of animal life so endowed. His object has been to point out the principal forms, and to indicate generally the mode of dealing therapeutically with the effects of the venom. JOSEPH FAYRER.

VENOUS HUM.—A peculiar murmur heard on auscultation of the larger veins, especially those of the neck and chest, in anæmia, and in cases of interference with the flow of the blood through these vessels. *See* PHYSICAL EXAMINATION.

VENTNOR, in the Isle of Wight.—A mild, dry, tonic climate. Mean winter temperature for forty years, 42·43° F. Sheltered from N., N.E., and E.; exposed to S.S.E. and S.W. winds. *See* CLIMATE, Treatment of Disease by.

VENTRICLES OF THE BRAIN, Diseases of.—SYNON.: *Maladies des Ventricules du Cerveau*; Ger. *Krankheiten der Gehirnhöhlen.*—The chief morbid states of the ventricles of the brain are (1) New-growths, Degenerations, and Inflammatory changes in the *lining membrane* (ependyma) and *velum interpositum*; and (2) Accumulations of blood, pus, and serum in the *ventricular cavity.* The more important of these changes are fully described in special articles.

1. Diseases of the Lining Membrane and Velum.—In old age, and in some degenerative brain-diseases, such as general paralysis, the ependyma of the ventricles becomes *thickened.* The surface is smooth, or, in some cases, covered by minute warty granulations. Some of the latter may attain the size of a pea, and constitute small fibrous tumours. Similar changes are sometimes found when the brain has been subjected for a long time to passive congestion. In rare cases the thickened membrane has been found *calcified* in places. A few *morbid growths* have been met with in the ependyma, the most common being the granulations of tuberculosis, which have been found both on the lining membrane and the choroid plexus. The latter and the velum interpositum frequently present thickening, and undue adhesion to the ependyma. In rare cases *fatty growth* has been met with in this situation. The choroid plexus may present partial *fatty degeneration,* and frequently contains *corpora amylacea.* Aggregations of *brain-sand* are common in the choroid plexus, and occasionally occur in the lining membrane.

Cystic degeneration is the most common morbid appearance in the choroid plexus, especially in that part which is within the descending cornu. The cysts are clear, delicate, colourless, transparent, from the size of a pea downwards. They consist of delicate cells pressed together; these are simply normal cellular elements of the part which have undergone a peculiar degeneration. In some of the larger cysts, these cells have been destroyed in the centre, so that a true fluid-containing cyst remains.

Adhesions sometimes take place between contiguous surfaces of the lining membrane; these may cut off one posterior cornu from the rest of the ventricle, and it may thus be obliterated by the union of its walls.

The ventricles may undergo passive *congestion* in common with other intracranial structures, or from pressure upon the veins of Galen, which carry the blood from the velum interpositum. The latter may cause effusion of fluid into the ventricles, but its influence was formerly over-estimated. The cause which obstructs the veins is generally a growth which also hinders or prevents the escape of fluid from the third through the fourth ventricle.

Inflammation involves both the ependyma and the velum interpositum. It is rarely confined to the ventricles, still more rarely to one. Commonly it is part of a general meningitis. The ependyma and the velum are thickened and pulpy, being infiltrated with cells of new formation. The velum is always injected; the ependyma may be injected or pale. Occasionally a 'false membrane' is found upon its surface. The tissue of the brain beneath the ependyma is softened, and may be injected. The fluid in the ventricles is increased in quantity, and is turbid from pus and exudation-cells, and even (it is said) from the *débris* of nerve-fibres. The inflammation, of which this is part, is usually tubercular and fatal; but, when simple, it may pass away, the ependyma and velum remaining thickened and adherent. *See* MENINGES, CEREBRAL, Inflammation of, Tubercular.

2. Intraventricular Accumulations. *Hæmorrhage* rarely occurs directly into the ventricles; it has resulted from the rupture of a vein by injury; but blood often enters them from within the cerebral substance, an ordinary hæmorrhage bursting into the cavity. Blood may even pass into the ventricles, from the subarachnoid space, by the passages through which it escapes. True *pus* may be found in the cavities, from the bursting into them of a cerebral abscess; and a purulent fluid may result from inflammation of the lining membrane. A slight amount of *serum* results from inflammation, but is rarely considerable, unless the escape of that secreted by the choroid plexus is prevented by the closure of the passage to the fourth ventricle or by the obliteration of the foramina in the membrane closing in the fourth ventricle, by which its cavity communicates with the subarachnoid space (Hilton) (*see* HYDROCEPHALUS). In atrophy of the brain, the fluid within the ventricles (as beneath the arachnoid) undergoes a considerable compensatory increase, which has been without reason regarded as a cause of symptoms.

Lastly, by violent commotions of the brain the septum lucidum may be *ruptured* (Wilks and Moxon).

Ventricular hæmorrhage and *Hydrocephalus* are described in special articles. *See* BRAIN, Hæmorrhage into; and HYDROCEPHALUS.

The other conditions discussed are marked by no distinctive symptoms, and call for no special treatment.

W. R. GOWERS.

VENTRICLES OF THE HEART, Diseases of.—*See* HEART, Diseases of.

VERDIGRIS, Poisoning by.—*See* COPPER, Poisoning by.

VERMES (Lat. worms).—This is a term of variable import, according to the practical or scientific standpoint from which it happens to be viewed. Thus Gegenbaur includes in this group, not only the helminths or entozoa and their allies, but also a multitude of creatures of widely differing structure, as well as the annulated animals properly so-called (*Grundzüge der vergleich. Anatomie*, 1870, s. 155 *et seq.*). The late Professor Rolleston, in like manner, elevates the term so as to make it of *sub-kingdom* value in zoology. Practically, the term 'Vermes' is used as the equivalent of *Entozoa*. *See* ENTOZOA.

VERMICIDES (*vermis*, a worm; and *cædo*, I kill).—A group of anthelmintics which kill worms. *See* ANTHELMINTICS.

VERMIFUGES (*vermis*, a worm; and *fugo*, I expel).—A group of anthelmintics which expel worms, but do not necessarily kill them. *See* ANTHELMINTICS.

VERRUCA (Lat. A wart).—SYNON.: Fr. *Verrue*; Ger. *Warze.*

DEFINITION.—A wart or papillary growth from the skin.

ÆTIOLOGY.—The wart, being an aberration of growth of certain of the constituents of the skin, must necessarily result from a want of normal power within the integument; hence it is mostly found in children and elderly persons, and is less frequently met with in the adult. As children become developed by growth and their tissues acquire strength, these partial exuberant growths disappear. In young persons of feeble organisation they are sometimes thrown out like an exanthem, and yield to a constitutional treatment directed towards the improved innervation and nutrition of the tissues. Their direct relation with the nervous system is often evinced by their sudden disappearance under the influence of mental emotion, a circumstance which has led to the popular use of charms for their cure. In elderly persons they are often met with on the face, where their presence must be ascribed to debility of integument; and they are frequently associated with dirt and neglect. Briefly, warts may be said to be due to aberration of nutritive function of the skin, consequent on defective organisation and vitality.

DESCRIPTION.—Pathologically a wart is an hypertrophy or excessive growth of a small group of papillæ of the skin, forming a hard prominence of the integument. Warts vary in size, and are modified according to situation. They sometimes cover a considerable extent of surface in patches several inches in diameter, but more commonly appear as tubercles, either few in number and isolated, or numerous and in clusters. One kind, the senile wart, is remarkable for the minimum of prominence, resembling a flat, dirty-looking blotch on the skin; whilst another, as on the hands, may have a prominence of a quarter of an inch, or on the scalp of half an inch.

Warts on the hands afford the commonest illustration of verruca, as in this situation, from the greater nutritive energy of the skin and the abundance of epidermis, they are most frequent and most highly developed. When of recent growth they are convex and smooth on the surface, but when of longer standing the apex is flat, from the wearing away of the superficial cuticle, and the anatomy of the wart becomes disclosed. Then it is apparent that the wart is composed of a bundle of fibres, held together in a cylindrical form by a boundary of thickened cuticle. Each of these fibres is a vascular papilla of the skin, enclosed in a sheath of cuticle, and the collective mass forms the body of the growth. An old wart will frequently split up into several segments—*V. lobosa* or lobulated wart, and then its construction of fibres

—*V. fibrosa*, is strikingly conspicuous. If a wart be cut through horizontally, the vascular papillæ will be cut across, and then the structure of a wart of papillæ and horny sheaths is still more evident. On the fingers, and especially the knuckles of children, the verruca is isolated and large; but it is not infrequently confluent, whilst on the back of the hands and wrists, as also on the forehead, it is often developed in crops, like an eruption; the latter, however, never attain the dimensions of the isolated warts of the fingers.

Verrucæ are generally sessile—*V. sessilis*; but on the scalp they are frequently pedunculate, and, from a peculiarity of structure, have been denominated digitate—*V. digitata.* The digitate character of the warts of the scalp is due to the lesser quantity of epidermis occurring in that region; consequently the hypertrophied papillæ are not held together by a ring of thickened cuticle as elsewhere, but, being left to themselves, shoot out from the centre like fingers; the papillæ likewise grow to a greater length, and their cylinder is swollen so that the bulk of the mass greatly exceeds that of the base from which they spring. Nevertheless, the digitate verruca must be distinguished from *V. acrochordon* and the cauliflower-shaped venereal warts. Both of these are growths of the integument, and are not restricted to the papillæ cutis alone; and thereby fall into the category of molluscum, with which, especially acrochordon, they are closely allied in pathological structure.

The normal colour of warts on the hands is a yellowish-grey, but from their roughness they are apt to retain dirt in their crevices, which gives them a brownish appearance. The flat warts of the trunk of the body and face are accompanied with the production of pigment, and their dirty colour is consequently more striking.

DIAGNOSIS.—True idiopathic warts must be distinguished from other diseases which sometimes put on a warty appearance, especially *carcinoma* and *syphilis*. *Epithelioma* of the skin is occasionally seen as a circumscribed warty growth, but generally with adherent scabs covering superficial ulceration. These signs, together with infiltration of adjacent tissues, implication of neighbouring glands, and pain, would arouse suspicion. It must be remembered, however, that epithelioma frequently attacks a simple wart which has remained quite passive during a lifetime; rapid increase of growth with the above-mentioned symptoms would suggest the supervention of epithelioma.

Any chronic inflammatory process of the skin, especially *syphilis*, is liable to take on a papillary character. Without referring to the papillary growths of early syphilis (condylomata), which could scarcely be confounded with simple warts, on account of their position and moisture, mention may be made of the dry warty character assumed by old syphilitic lesions, especially such as have been preceded by ulceration. The history of the disease (previous ulceration, &c.), together with other concomitant symptoms of syphilis, would assist the diagnosis.

As of venereal origin, though never syphilitic, ordinary *venereal warts* must also be noted. Other names by which they have been described suggest their characters, such as 'pointed condyloma,' and 'cauliflower excrescence.' They are generally bright red in colour; and the individual papillæ are pointed. The rapidity of their growth, and the situation where they usually occur (the genitals), serve to distinguish them from verrucæ. Moreover, they most often accompany gonorrhœa, being caused by the irritating discharge.

Cadaveric warts are described under POST-MORTEM WOUNDS.

PROGNOSIS.—Verruca is a blemish rather than a disease, and unimportant in its relations to the general health. By an error of diagnosis we sometimes read of malignant warts; and warts have been confounded with those fleshy growths termed 'tegumentary nævi.' Moreover, in elderly persons a warty state of the skin is sometimes associated with asthenic ulceration, and occasionally with rodent ulcer, for which the depraved state of the skin, and not the wart, is responsible.

TREATMENT.—The best method of treating verrucæ is to touch them with some solvent agent, such as acetic acid. This acid dissolves the epidermis, and, reaching the vascular papillæ, destroys the whole structure of the wart down to its root. The pulpy mass then dries up into a scab; and when the scab falls off, the growth rarely reappears. This little operation may either be completed at one sitting, or it may be repeated daily until its purpose is effected. Where there are numerous verrucæ to be dealt with, the process is tedious, and is generally left in the hands of the patient. The writer prefers a saturated solution of caustic potash, carefully applied by means of a minute pencil of sponge fastened to the end of a stick. The alkali acts more speedily than the acetic acid, and effects a more thorough cauterisation of the vascular plexus, from which the hypertrophied papillæ derive their capillary loops. The verrucæ digitatæ of the scalp are speedily and easily removed by this process. In the exanthematous form the verrucæ are too small and too numerous for the caustic application. These may be treated by friction with sulphur ointment or tar ointment; and in this latter form the verrucæ are frequently entirely removed by a course of treatment with liquor arsenicalis, in three or four minim doses, taken immediately after meals, three times a day. ERASMUS WILSON.

VERTIGO (*verto*, I turn).—SYNON.: Giddiness; Dizziness; Swimming of the head; Fr. *Vertige*; Ger. *Schwindel*.

DEFINITION.—The consciousness of disordered equilibration.

PHYSIOLOGICAL RELATIONS. — To understand vertigo normal equilibration must be briefly considered. The equipoise is maintained by a sensori-motor mechanism. The coördinating centre is the cerebellum; the afferent or sensory apparatus consist of visual, tactile, muscular, and labyrinthine impressions; the efferent or motor apparatus are the muscles, chiefly those of the head, neck, spine, and lower extremities. Derangement of any part of this mechanism may lead to vertigo, by the interruption of its power of adjustment being appreciated by cortical centres. Vertigo is often associated with reeling or staggering, and is incorrectly said to cause it. Actually vertigo is the consciousness of disturbed locomotor coördination—a rudimentary disorder of coördination of locomotive movements (Hughlings Jackson), whilst reeling is an adaptive effort to preserve the equilibrium. It is quite possible that cortical centres in an unstable condition may give rise to vertigo, without there being any disease or disturbance of subordinate centres, or of peripheral impressions. Dr. C. L. Dana has recorded two cases in which vertigo and staggering occurred, associated in each case with a lesion of the temporal lobe. It is probable the migrainous vertigo is due to discharging lesions of the cortical centres concerned in the consciousness of equilibratory perceptions. A fact that supports the assertion that vertigo is a rudimentary disorder of coördination, is that when in a person, who has a sensation as if he were moving or turning in a certain direction, movements actually take place, they are always in the direction in which he previously felt he was turning when no outward movements occurred. Experimental researches and observations in disease have established the conclusion that the semicircular canals take an important share in normal equilibration; injury and disease of these parts occasioning locomotive incoördination, temporary when one side only is deranged, permanent when both sides are involved. The arrangement of the semicircular canals, and the physical principles involved in their actions, are very complicated, but have been carefully studied and explained by Flourens, Cyon, Crum-Brown, and others; and it has been demonstrated by Flourens that injury of each canal is followed by definite locomotive disturbance, causing the body to tend to fall, or actually to fall, in a definite and precise direction, forwards, backwards, or to one or other side, according to which of them is injured. The sensory impressions originating in the semicircular canals are caused by varying tension of the endolymph, communicated to the vestibular division of the auditory nerve spread out on the ampullæ of the membranous canal. Variations in labyrinthine tension may be produced by alterations in the position of the head, by differences in the vascular tension of the labyrinthine blood-vessels, and by the varying pressure in the middle chamber of the ear, induced by obstruction of the Eustachian tube, spasm of the tensor tympani muscle, and other causes; and it may also be due to disease of the labyrinth itself, or communicated to the labyrinth. Doubts have been thrown on the experimental evidence that disturbed equilibration is due to injuries to the semicircular canals by Ewald, Steiner, Böetcher, &c., and the effects have been attributed to injuries to the brain produced in the experiments. Schiff's observation that section of the auditory nerves does not cause disturbance of equilibration does not negative irritative lesions of the membranous canals giving rise to it. The fact that whilst injuries to the bony canals do not give rise to movements, injuries to the membranous canals do cause movements, is of much significance. Moreover, it is asserted that 'if the horizontal canal is laid bare, and the membranous canal opened so as to expose the endolymph, blowing gently over the opened canal with a fine glass cannula will produce a definite movement of the head, which is turned to the one side or to the other, according as the current of air drives the endolymph towards or away from the ampulla. From this it is inferred that a movement of the endolymph over, or an increased pressure of the endolymph on, the surroundings in the ampulla gives rise to afferent impulses which in some way determine the issue of efferent impulses leading to the movements of the head' (Michael Foster). In some cases of aural vertigo, the giddiness is much influenced by the position of the head, and it is only in certain positions that this symptom is produced. This is readily accounted for on the supposition that the disease causing it is in the semicircular canals, which are so arranged as to lie in the three directions of space, and change in the position must affect the pressure of the endolymph on the various ampullæ, resulting in adjustment of position when the coördinating centres are in proper working order, but when these are deranged leading to the consciousness of disordered equilibration or vertigo. As far as is known, change in position cannot in any similar manner disturb the relations of the auditory nucleus, nor the brain itself; though it must be admitted that in migraine, which is a cortical disease, alterations in position may intensify or cause vertigo. Further, the evidence supplied in a *post-mortem* examination of a case of Menière's, where hæmorrhagic inflammatory material was found in the semicircular canals, and no disease of the brain, proves that disease of the semicircular canals *per se* may give rise to vertigo. Visual and tactile impressions are liable to be deranged in many ways, for instance, by unexpected or unusual movements, as in swinging, being at sea, &c.; by local disease of the visual and tactile apparatus; and by disease in the nerve-trunks and spinal cord, interrupting conduction from the periphery to the centre. By disturbances in visual, tactile, or labyrinthine impressions the equilibrising centre is uninformed or misinformed, and incoördination results, outwardly shown by reeling or falling, and inwardly by the sensation we call vertigo. Loss or perversion of visual or tactile sensations may be compensated for, if the two remaining sensory processes continue intact, but nothing compensates for entire loss of labyrinthine impressions (Ferrier). The vestibular nerve which is distributed to the semicircular canals is a branch of the auditory, the nucleus of which in the medulla is in close relation with that of the vagus; and thus the fact is explained that disturbances in the large area of distribution of the pneumogastric are found associated with labyrinthine disease, by propagation of the irritation from the nucleus of the auditory to that of the adjacent vagus; and conversely, the intimate association of these two nuclei enables us to understand how disease of the stomach and other viscera occasions vertigo. It must further be borne in mind that the labyrinth receives its blood-supply from the vertebral artery, which at its origin from the subclavian is in near propinquity to the inferior cervical ganglion of the sympathetic, from which it receives a rich plexus of nervous filaments. The inferior cervical ganglion also sends communicating branches to the vagus, and branches to the heart. In this double way, therefore, the labyrinth has important nervous relations with the stomach, heart, and other organs.

PATHOLOGY.—Vertigo may be excited by variations in the local or general blood-pressure, which cause variations in the labyrinthine tension, as in anæmia, gout, and other affections. It may be excited reflexly by disease of the nose (*vertigo a naso læso*, Joul), or by disease of the larynx. The symptom is also produced by certain drugs, such as quinine, salicin, and the salicylates, which may act on the labyrinth through the vascular system, as is rendered probable by the deafness and tinnitus accompanying it, but which may be due to its action on the auditory nucleus, or the cortical centres concerned in consciousness of auditory perceptions. Vertigo may be excited by sending a galvanic current through the head from one mastoid process to the other, but the exact mode of its action is not known.

Vertigo may be divided into degrees or stages, namely, (1) a feeling of confusion and instability; (2) a feeling as if objects are moving; (3) a feeling as if the individual himself is moving; and (4) actual movements of the body.

VARIETIES.—The important forms of vertigo which occur in practice will be further considered under the following heads: (1) Ocular; (2) Auditory; (3) Gastric; (4) Nervous; (5) Epileptic; (6) Migrainous; (7) with organic brain-disease; and (8) Gouty.

1. Ocular Vertigo. — Vertigo is frequently caused by ocular disorders, and is often mistaken for serious cerebral disease. The simplest form is in paralysis of a single muscle, as the external rectus. The vertigo is not occasioned by the diplopia, but by the incorrect notion formed of external objects by the paralysed eye, due to what is known as 'erroneous projection.' The confusion thereby produced gives rise to vertigo, and often to reeling. One of the most important varieties of ocular vertigo is that occasioned by insufficiency of the internal recti muscles—*muscular asthenopia.* This is most commonly met with in myopia. During reading, these muscles, which have long been overtaxed by exertions to maintain the convergence of the eyes rendered necessary when looking at near objects, suddenly give way under the strain; they relax, the eyeballs turn out, and the letters on the page become indistinct, run into each other or overlap, and a sense of confusion and giddiness occurs. It is usually accompanied by aching at the backs of the eyes, headache, and sometimes by nausea. Such cases are often misunderstood even by medical men. Muscular asthenopia may occur also with hypermetropia; and as a sequel to exhausting diseases, such as fevers and diphtheria. Many instances are recorded where, owing to this cause of vertigo not being recognised, serious errors of diagnosis and treatment have resulted. For the diagnosis of the particular optical defect and treatment, the reader is referred to the article VISION, Disorders of.

2. Aural or Auditory Vertigo.—SYNON.: *Vertigo ab Aure Læsa*; Labyrinthine Vertigo; Apoplectiform Vertigo; Menière's Disease.

Aural vertigo is very generally known by the name of Menière's disease, from the excellent description of the malady first given in 1861 by Menière, though strictly this term should be restricted to cases of an acute or apoplectiform character. Under the term 'Menière's disease' is grouped a class of cases in which vertigo is caused by perversion or abeyance of the labyrinthine function. The labyrinthine disturbance may be caused either (1) *directly* by an affection of the labyrinth, such as (*a*) hæmorrhage, (*b*) congestion and inflammation; or (2) *indirectly*, by (*a*) disease of the middle ear (otitis media), (*b*) obstruction of the Eustachian tube, (*c*) spasm of the tensor tympani, or paralysis of the stapedius, or (*d*) irritation or obstruction of the external auditory meatus, and pressure on the membrana tympani, as by cerumen, foreign bodies, or by syringing the ears, especially when the membrana tympani is perforated. Thus the labyrinthine affection may be either of an irritative or of a destructive nature, and the effect of the lesion will be exactly the reverse in the two cases (Ferrier). That is to say, whilst an irritative lesion would cause the tendency to fall in one direction, a destructive lesion of the same canal would cause a tendency to fall in the opposite direction. In Menière's disease, strictly speaking, there is always coincident disturbance in the functions of semicircular canals and cochlea, as indicated by the three most important associated symptoms—vertigo, tinnitus, and deafness. Accompanying these cardinal symptoms there are accessory phenomena, due to secondary visceral disturbance, namely, pallor, faintness, and nausea or vomiting—a condition of syncope. Dr. Buzzard has recently done good service in suggesting that in some cases of aural vertigo the lesion, often a functional one, may be in the medulla oblongata, and pointing out that a lesion of the auditory nucleus would, by the laws of peripheral perception, be referred to the terminations of the nerve in the semicircular canals or cochlea, or in both. Aural vertigo is rare in young persons, and is chiefly met with in the later half of life. It is more frequent in men than in women.

The disease makes its appearance, in a person apparently quite well, or the subject only of some chronic aural disease, with a loud noise in the ear, compared by different persons to the whistle of a steam-engine, the firing of a gun, or the roar of the ocean. When a person, as not infrequently happens after the first attack, has an habitual noise in the ear, this at the time of the attack is sometimes, but not always, greatly exaggerated. The noise, which is wholly or principally in one ear, is soon followed by the feeling of giddiness. This is generally of a high grade, causing the sensation of surrounding objects moving in some one direction, a feeling of translation of the patient's body in the same direction, or actual movements of the body. The movement, whether apparent or real, is usually *from* the side on which the ear is affected. In recurring attacks the movements, whether of objects or of the individual, are nearly always in the same direction. Usually the sensation of movement is from behind forward, or to one or the other side, or the patient has a feeling of rotation in a vertical axis. When in bed, the room, bed, and occupant are felt as if turning round and round, or rising or sinking. Accompanying the vertigo there is reeling, and the patient clings to surrounding objects for support. In some cases the movement is too rapid for the patient to obtain security in this way, and he is thrown to the ground, sometimes with such violence as to occasion serious injuries. One patient described the sensation as 'if his heels went up into the air.' When falling takes place, it is usually forwards or to one side. It is, however, to be especially remembered that, except in rare cases, there is no loss of consciousness; the patient being able immediately after the attack to describe the sensations he experienced, or even to answer questions in the attack itself. In some cases deafness, more or less complete, but sometimes transitory, follows—at an appreciable interval—the vertigo, and in some cases is altogether wanting. Following, in more or less rapid succession, the tinnitus and vertigo, there occur nausea and in most cases vomiting, accompanied by pallor of the face; the skin becomes cold and covered with a clammy sweat. In some cases oscillatory movements of the eyes are observed. It is generally asserted that objects appear to move in a direction opposite to that of the ocular movements. This is not universally true; and probably, contrary to the statements of most writers, the apparent movements of objects is in the same direction as the observed movements of the eyes. Gradually the attack passes off; the noises in the ear lessen, but deafness is left behind. The body recovers its warmth, and the pallor subsides, but vertigo and vomiting may persist for some hours or even days, both being aggravated or induced by rising from a horizontal position. Slight attacks may only last a few minutes. In cases where there is a direct lesion of the labyrinth, a certain degree of deafness—a limitation of the field of audition, that is, the loss of certain sounds in the musical scale—and tinnitus remain. The patient is in all other respects well, except for the dread of a recurrence of the attack. Occasionally, however, a certain degree of vertigo and reeling persist, liable to be aggravated by gastric derangement. The writer has known a patient who had extremely severe and typical attacks, who both previously and subsequently suffered from functional dysphagia between the attacks—a full-sized bougie could be easily passed. It was evidently due to disturbance in the vagus nucleus. A patient rarely escapes with one attack. Subsequent attacks are separated by distinct intervals, but in severe cases these may become less and less, until a permanent vertiginous state, of a most distressing character, may be reached, liable to paroxysmal exacerbations. In such very grave cases spontaneous cure may occur on the establishment of complete and permanent deafness, or relief may be obtained by therapeutical measures. When the labyrinthine disturbance is secondary to disease of some other part of the auditory apparatus, removal of the primary disease, as cerumen or tympanic catarrh, will, when practicable, promptly remove the symptoms, and the attacks may not recur.

Diagnosis.—Menière's disease has to be distinguished from epilepsy, apoplexy, gastric derangement, and other forms of vertigo. From all these it is distinguished by the almost invariable co-existence of tinnitus, deafness, and vertigo; with, in addition, a tendency to syncope and nausea, or vomiting. The concurrence of the first three symptoms renders it probable that the labyrinth is involved, a point which will be further established by testing audition with a tuning-fork and watch. The vertigo is generally of movement in a certain definite and uniform direction. There is never numbness, tingling, or any sensations analogous to an aura; but aching of the upper extremities, and discoloration of the hands, may occur, from irradiation of the irritation from the inferior cervical ganglion to the brachial plexus (Woakes). As to the diagnosis of the nature of the labyrinthine affection, whether primary or secondary, some rules have been laid down by authorities. If a person who has formerly heard well becomes suddenly deaf, or hard of hearing, with the symptoms of an apoplectic attack, and if there is at the same time an uncertain and staggering gait, but no symptoms of paralysis in the nerve-tracts, and if the examination shows a normal membrana tympani, and perfectly permeable Eustachian tube, we may believe with great probability that there is an affection of the labyrinth (Tröltsch). Deafness and tinnitus occurring without vertigo indicate an affection of the middle ear. Vertigo and tinnitus without deafness may be due to a similar affection of the middle ear. Vertigo, tinnitus, and deafness are certainly due to an affection of the labyrinth. When the vertigo is markedly influenced by changes in the position of the head, it is, in the writer's opinion, strong evidence that the disease is in the labyrinth. At the same time it is held by some authorities that in the present state of our knowledge we are not in a position to speak as to the exact seat of the lesion in cases of aural vertigo, though it must be in some part of the auditory nerve, or in the part of the brain where auditory impressions are perceived. Careful otoscopic examination should be made, the permeability of the Eustachian tubes tested, and the tuning-fork and watch employed to ascertain the condition of the conducting apparatus, before an exact opinion can be formed as to the seat and nature of the disease. Vomiting, following the ingestion of some rich or indigestible food, may be so severe and lasting as to monopolise attention, and the vertigo and tinnitus may not be complained of. In such a case, a mistake may readily occur in a first attack.

Prognosis. — Where the labyrinthine affection is due to some remediable defect, the disease will subside on removal of the cause, such as cerumen or tympanic catarrh; hence the great importance of an exact diagnosis as to the nature of the case. When the lesion is primarily of the labyrinth, a certain degree of deafness and tinnitus is nearly always left, and recurrence of the attack is to be anticipated, though some cases recover completely under treatment. In some instances the tinnitus and vertigo may cease on the patient becoming completely deaf.

Treatment.—In the attack, and for a short time following it, the recumbent position should be strictly maintained. Bromide of potassium or ammonium, in ten to twenty grains for a dose, should be administered, and small pieces of ice swallowed. Next, any gastric derangement should be corrected, for in some cases such derangement excites a paroxysm in a person predisposed to it by some aural affection, insufficient alone to induce an attack. Alkalis and vegetable bitters, with or without bismuth, will generally be useful for this purpose. Any abnormal local condition must be treated. Subsequent to the attack quinine in full doses, 3 to 5 or 10 grains three times a day, perseveringly used, is sometimes attended with the best results (Charcot). The writer has seen many cases which corroborate this statement. Gelsemium and salicylate of sodium have been found useful (Gowers). Counter-irritants, including the actual cautery, applied to the mastoid region, have proved serviceable in some cases, and may be used in addition to other measures. Threatened attacks of aural vertigo may be often avoided, especially in cases in which arterial tension is high, by a dose of calomel, and it is a good plan to give a patient liable to attacks calomel powders (gr. iij. or v.) to be always carried in the pocket-book, and order one to be placed on the tongue when any threatenings occur.

3. **Gastric Vertigo.**—Synon.: *Vertigo à Stomacho Læso.*

Vertigo, occasionally of a high grade, sometimes accompanies chronic gastric derangement. It is more common with slight than with grave affections of the stomach, but has been met with in well-marked organic disease of this organ. An explanation of its occurrence has been given in the introductory remarks. It sometimes occurs soon after a meal, but more often when the stomach is empty (Trousseau). At the same time it is now generally agreed that cases of gastric vertigo are much less common than Trousseau's description would lead one to believe. In the majority of such cases some ear-disease is revealed by careful examination. Associated with the vertigo are usually pain and a feeling of fulness in the stomach, increased by food; heartburn; eructations; vomiting; flatulence; and pain in the left hypochondrium and chest. The bowels may be torpid, or diarrhœa may be present. The patient often suddenly experiences a swimming in the head, objects may appear to revolve, the patient's gait becomes tottering, and he may even fall. Often there is constrictive headache, faintness and pallor with nausea, and sometimes troublesome vomiting, but there is no loss of consciousness. Visual hallucinations may be present, and buzzing in the ears experienced, but there is no deafness. The vertiginous symptoms may so predominate that the gastric symptoms may not be complained of; but treatment directed against dyspepsia cures the vertigo. When predisposing gastric disturbance is present, trivial causes, such as looking at objects which lead to confused visual impressions, may excite an attack, but this may also arise spontaneously. In many cases relief is obtained by the recumbent position, but attacks may occur when the patient is lying down.

DIAGNOSIS.—This form of vertigo is diagnosed from epilepsy by absence of loss of consciousness; and from labyrinthine vertigo by the absence of deafness, and the physical signs of aural disease. It cannot be concluded that the vertigo is essentially gastric without thorough examination of the ears, for, as already stated, vertigo may be excited by gastric disturbance when there is labyrinthine affection insufficient alone to determine an attack. It must also be remembered that signs of gastric and intestinal derangement are induced in Menière's disease, and may be so prominent as to cause the aural affection to be overlooked.

4. Nervous Vertigo. — SYNON.: Fr. *Vertige Nerveuse.*

Not uncommonly, vertigo is one of the most troublesome symptoms of nervous exhaustion and depression. This occurs in persons unduly taxing their nervous powers, by severe intellectual strain, especially when combined with anxiety, or by sexual excesses. It occurs also from the depressing effects of the immoderate use of tobacco, alcohol, and tea. The vertigo rarely reaches a high grade, manifesting itself by a sensation of confusion, or of objects revolving, occasionally only by the feeling of a tendency to fall. It may be associated with a slight reel, but more often the patient feels as if he were walking unsteadily, when there is no perceptible peculiarity of gait. As a rule giddiness is only experienced in the upright position, but in some cases it occurs when the subject is recumbent, and the patient often complains of sudden and violent startings when just in the act of falling asleep. It is often intensified by an elevated position, and in large buildings and assemblies. Hence it is often experienced in church. It is peculiarly distressing, owing to the sufferer's emotional equilibrium being easily disturbed, and is frequently associated with a dread of impending cerebral disease—epilepsy, apoplexy, insanity, &c. There often co-exist gastric derangement and flatulence, with irritability of the heart, palpitation, and sleeplessness. There may be slight and temporary buzzing in the ears, but deafness is absent, and loss of consciousness does not occur. In these respects it is readily distinguished from Menière's disease and *petit mal.*

TREATMENT.—This variety is to be treated by removal of the cause—over-work, excessive sexual indulgence, or the abuse of alcohol, tobacco, or tea; by correction of any dyspeptic symptoms; and by the administration of nervine tonics, such as iron, quinine, or strychnine. Bromides should be avoided if possible.

5. Epileptic Vertigo. — Vertigo may occur in a slight fit of epilepsy, or at the commencement of a severe attack. The symptom may replace an epileptic fit, or may co-exist with epilepsy. It is more common in epileptic vertigo for the patient to imagine that he himself is moving or turning round, than for external objects to appear in motion (Russell Reynolds). Care must be taken not to accept the patient's mere statement of 'giddiness.' The term is often loosely applied. It is necessary to ascertain his exact sensations, and only to conclude there is vertigo when actual feelings of movement are experienced. If the vertigo is related to change of position of the head, it is probably labyrinthine. The latter is not usually accompanied by loss of consciousness, and is more apt to be followed by vomiting (Gowers).

6. Migrainous Vertigo.—Vertigo commonly constitutes one of the phenomena of migraine, occurring as a rule after the disorders of sight, touch, and speech, when these form part of the seizure, and either attends or follows the development of the headache (Liveing). Vertigo sometimes replaces the attacks of migraine. It is apt to occur on change of posture, or on suddenly turning the head. As a rule, migrainous vertigo is slight in degree, but it may be quite severe, and accompanied by nausea and vomiting. It is unassociated with noises in the ear, or with deafness. *See* MEGRIM.

7. Vertigo in Connexion with Organic Disease of the Nervous System. Vertigo sometimes accompanies disease of the cerebrum, both acute, as apoplexy, and chronic, as a tumour. There are reasons for believing that vertigo may be excited by cortical lesions, thus explaining epileptic and migrainous vertigo. Diseases of the cerebellum and of its middle crura are often attended with reeling gait, and sometimes with vertigo. This symptom sometimes accompanies the ataxy of tabes dorsalis; and is a marked symptom of some cases of insular sclerosis.

8. **Gouty Vertigo.**—Vertigo, labyrinthine or other, is occasionally met with in gouty persons. It may disappear after an outburst of gouty arthritis; or be removed by alkalis, colchicum, salicylate of sodium, mercury, and other proper remedies, and attention to diet.

A peculiar form of disease has been described by Dr. Gerlier of Fernex, Switzerland, which he has called 'paralysing vertigo,' and which subsequent writers have named 'Gerlier's disease.' It consists of three groups of symptoms: (1) muscular weakness in the neck or trunk muscles and legs, and occasionally in the hands; (2) pain in the neck and occiput; (3) ocular symptoms, of which ptosis is the most common. Occasionally diplopia and amblyopia are present. Dizziness or mistiness before the eyes is often present, more rarely rotatory vertigo. The attacks usually occur about once or twice a day, and between the attacks the patient is well. The disease has only been observed in some Swiss villages on the French frontier, where the malady has received the name of *le tourniquet.* It appears to have had a kind of epidemic prevalence. Its nature is very doubtful, but appears to be a functional disturbance or psychosis. No evidence of organic disease has been present in the cases recorded.

STEPHEN MACKENZIE.

VESICAL DISEASES.—*See* BLADDER, Diseases of.

VESICANTS (*vesico*, I blister).—A class of counter-irritants which produce blisters. *See* COUNTER-IRRITANTS.

VESICLE (*vesicula*, diminutive of *vesica*, a bladder).—SYNON.: Fr. *Vésicule*; Ger. *Bläschen.*

DEFINITION.—An elevation of the corny layer of the epidermis, caused by a minute circumscribed collection of serum between it and the mucous layer beneath.

DESCRIPTION.—Vesicles may be minute or of considerable dimensions; a vesicle of the size of a millet-seed gives the name to the cutaneous affection *miliaria.* The vesicles of eczema are minute and frequently confluent; those of scabies are occasionally acuminated; the vesicles of varioloid are not uncommonly umbilicated; those of herpes iris are developed in rings; the vesicles of ordinary herpes attain the bulk of a split pea; and the vesicles of pemphigus, on account of their large size, are called 'bullæ.' The contents of a vesicle are apt to modify its name, since a vesicle containing a purulent fluid or pus is termed a 'pustule.' The ordinary course of a vesicle is to lose its fluid by evaporation, absorption, or rupture of the distended cuticle; to dry up into a thin scale; and to terminate by desquamation, without further lesion of the skin.

TREATMENT.—The treatment of vesicles is fully described under the heads of the several diseases of which they are a symptom. *See* CHICKEN-POX; HERPES; MILIARIA; and PEMPHIGUS.

ERASMUS WILSON.

VESICULAR EMPHYSEMA.—A form of emphysema of the lungs, in which the alveoli are distended with air. *See* LUNGS, Emphysema of.

VIABLE (*vie*, life).—SYNON.: Fr. *Viable*; Ger. *Lebendig.*—An epithet applied to a newly born child, to indicate its capacity for maintaining an independent existence. Viability has chiefly to be determined by the age of the fœtus, and by its condition as regards formation, health, and strength (*see* FŒTUS, Diseases of the). It has also been supposed to depend in some measure upon the season of the year in which a child is born (*see* PERIODICITY IN DISEASE). The question of viability has important medico-legal bearings, for which reference should be made to works upon forensic medicine.

VIBICES (*vibex*, a wale).—SYNON.: Fr. *Vergetures*; Ger. *Striemen.*—A term applied to patches of discolorisation on the surface of the body, somewhat resembling the marks of stripes or wales, and due to the presence of altered blood in the part. Vibices may arise either during life, as the result of a variety of causes (*see* EXTRAVASATION); or after death, as one form of cadaveric lividity or hypostasis. *See* DEATH, Signs of.

VIBRATION.—This word is sometimes employed as a synonym for fremitus. *See* FREMITUS; and PHYSICAL EXAMINATION.

VIBRIO (*vibro*, I shake).—SYNON.: Fr. *Vibrion*; Ger. *Zitterthierchen.* *See* MICRO-ORGANISMS.

VICARIOUS (*vicarius*, in place of another).—This word signifies substitution, and in physiology and pathology implies that some part or organ performs certain functions, or is morbidly affected, instead and in the place of some other part or organ, thus becoming a substitute for it. The notion of vicariousness is chiefly associated with a discharge of blood, whether physiological or morbid. Thus, it is very common to speak about *vicarious menstruation*, which is understood to mean that the discharge of blood that takes place normally from the uterus at the menstrual period, either does not occur at all, or only imperfectly, and that its place is taken by hæmorrhage from some other part, evidenced by epistaxis, hæmoptysis, hæmatemesis, or other forms of bleeding. The same idea is extended to morbid hæmorrhages, such as bleeding from piles, when this becomes habitual in an individual at frequent or regular intervals. It is supposed that bleeding may sometimes take place from other parts as a vicarious hæmorrhage, instead of from the hæmorrhoids.

Again, discharges, whether normal or morbid, as of secretions, mucus, pus, or other materials, are believed by many to exhibit a vicarious relation to each other in some instances, coming from one part while ceasing or diminishing at another, and so on. This may be illustrated by expectoration and diarrhœa in phthisis, which appear to modify each other as to their amount in some cases of this disease. Further, secretions and excretions are regarded as acting vicariously with reference to each other. Thus some of the secretions of the alimentary canal are undoubtedly capable of acting mutually as substitutes, and this may be looked upon as an instance of vicarious action; while such a connexion existing between the perspiration and urine is generally recognised.

Certain morbid conditions are also considered as having a vicarious relation. For example, congestion of or hæmorrhage from one part may take the place of congestion at another; or inflammation in one region may be the substitute for inflammation in another region.

There is probably more or less truth in these notions of vicariousness, as applied in relation to physiology and pathology. In actual practice, however, no case ought to be regarded as belonging to this category, without careful and thorough investigation. It has happened that hæmorrhages supposed to be vicarious of menstruation, have been important signs of grave diseases, such as gastric ulcer, or pulmonary phthisis. The principle may be of value in certain conditions as an indication for treatment.

Frederick T. Roberts.

VICHY, in Allier, France.—Thermal alkaline waters. *See* Mineral Waters.

VIDAGO, in Portugal.—Bicarbonated alkaline waters, with lithium and arsenic. *See* Mineral Waters.

VIGILIA.—Wakefulness; a term formerly applied to conditions of insomnia, but now little used and almost obsolete. *See* Sleep, Disorders of; and Coma-Vigil.

VILLOUS GROWTH (*villus*, hair).—A growth composed of hypertrophied villi. *See* Tumours.

VIRGINIA SPRINGS, in Virginia, United States.—Sulphur waters. *See* Mineral Waters.

VIRULENT (*virus*, a poison).—Primarily this word signifies connected with virus or poison. It is generally, however, employed to indicate great intensity or malignancy of a disease; for example, *virulent inflammation*, *virulent bubo*, and *virulent small-pox*.

VIRUS (Lat.).—Literally this word signifies a poison, but in medical language it is used to designate any kind of contagious material. *See* Contagion.

VISION, Defects of.—Synon.: Fr. *Troubles de la Vision*; Ger. *Sehenstörungen.*

Sight may be defective as to perception of *form*, of *colour*, or of *light*; and the whole, or only a part of the *visual field* may be affected. Sight is also disordered whenever *binocular single vision* becomes difficult or impossible (*see* Strabismus); and when *visual endurance* is impaired. The terms 'vision' and 'sight,' as commonly used, indicate acuteness of vision, and refer to the perception of form at the yellow spot. In this article disorders (A) of *perception of light*, (B) of *perception of colour*, and (C) of the *visual field*, will be shortly alluded to; but attention will be chiefly given to (D) disorders of *acuteness of vision* caused by optical defects in the eyes.

A. **Disorders of Perception of Light.**—Perception of light is equally good in all parts of the retinal area, except the most peripheral zone, which appears to be blind. Impaired perception of light causes disproportionate defect of vision by dull light—'night-blindness.' It may affect the whole field, or only its periphery. It occurs chiefly in diseases of the outer layers of the retina, especially syphilitic retinitis and retinitis pigmentosa, and sometimes in chronic glaucoma. Lowered light-sense over the whole field occasions the symptoms in the peculiar disease known as functional or endemic nyctalopia (*torpor retinæ*). The opposite condition, day-blindness with true retinal photophobia, is much rarer and more obscure. It is usually congenital, and accompanied by nystagmus, amblyopia, and colour-blindness. *See* Nyctalopia; and Hemeralopia.

B. **Colour-Blindness.**—Synon.: *Dyschromatopsia*; *Achromatopsia.*—This, when *congenital*, is usually not related to any other defects of vision. Congenital colour-blindness occurs with greater intensity and far greater frequency in males than in females (M. about 3·5 per cent.; F. ·2 per cent. or less). It is shown by more or less want of power to distinguish between certain colours, and depends on want (complete or incomplete) of one of the three fundamental colour-sensations (red, green, violet). The spectrum seen by a red-blind person appears shorter at its red end than it does to one with normal colour-vision, and he sees in it only two chief colours. The red, orange, yellow, and green are all 'green,' the blue and violet are 'blue,' and the two are separated by a neutral or 'white' band at the part that to the normal eye is bluish-green. In green-blindness the spectrum is not shortened, but the red, orange, yellow, and green are 'yellow' of various shades, or sometimes 'red'; the neutral band is in the pure green. Violet-blindness is rare; in it the spectrum is shortened at the violet end. It is often impossible to distinguish red-blindness from green-blindness with certainty except by using the spectrum; and in ordinary examination the two forms are best grouped together as 'red-green-blindness.' In incomplete red-green-blindness, green, bluish-green, and often rose are confused with grey of corresponding shade, and red is confused with shades of brown, greenish-brown, and yellowish-brown. In a complete case full green and scarlet look identical, and dark yellows are more or less confused with them. The best test (of many) for ordinary use is the one due to Holmgren of Upsala, in which a skein of Berlin wool, of a particular colour and shade (green, rose, or red), is given to the patient, and he is required to match it with all the others which seem to him of the same or a similar colour, amongst a large bundle of skeins of many colours. He is not usually allowed to name the colours, because even the colour-blind often guess the colours of common objects correctly. A very pale, pure green is the first test used; and the colour-blind, even of slight degrees, will match with it not only other green skeins, but also shades of pale grey, buff, and pink. Slight cases may easily be overlooked, unless the wools are carefully selected, and the examiner practised. Red and green are not well seen even by the normal eye, except at the central part of the visual field (*i.e.* the field for these colours is smaller than for white); but even at the periphery these colours are recognised if very brightly lighted and of large size.

Acquired colour-blindness often comes on in degenerative or inflammatory diseases which begin in the optic nerve. It is rare in diseases of the retina, and in glaucoma. Like the congenital form, it usually concerns only, or chiefly, red and green. It may affect the whole visual field of these colours, or only certain parts, a gap, or 'scotoma,' being present, on the area of which the red and green are not perceived in their true colours. When acquired colour-blindness is well marked in the whole extent of the field, in cases of disease of the optic nerve, the prognosis for sight is generally very bad; but if it be localised on a central scotoma, even though it may there reach a high degree, the prognosis is usually good. Progressive atrophy of the optic nerve, however, occasionally reaches a very high degree without any colour-defect.

C. **Disorders of the Visual Field.**—The visual field is the whole surface visible to one eye singly whilst at rest. It forms a concave surface, all the points of which are equidistant from, and perpendicular to, their corresponding points on the retina. In the outward and downward part it reaches to 95° from the centre; inwards, upwards, and downwards only to about 60°. Projected on a flat surface it thus forms an oval. The centre of the field ('fixation point') corresponds to the yellow spot, and the 'blind spot' is about 15 degrees outwards from this point. In order to measure the field roughly, the patient, placed with his back to the light and covering one eye, looks steadily from a distance of eighteen inches at the nose or eye of the observer, who then moves his hand, or a small object, such as a square inch of paper, about in the different parts of the field, and notes any places where the object is invisible or badly seen. This test, carefully applied, will detect any considerable loss of the field. Or the patient may gaze at a spot on a black board about one foot off, and a piece of white chalk be moved from various places at the periphery until it comes into view; a line joining these points will form the boundary of the field. For accurate measurements a special instrument, the Perimeter, is necessary.

D. **Disorders of Perception of Form.** SYNON.: Acuteness of Vision; *Visus*; *V.*; Fr. *Acuité Visuelle*; Ger. *Sehschärfe*; *S.*—Perception of form is normal only when the image of the object looked at falls on the bacillary layer of the retina, at the centre of the yellow spot, is clearly defined, sufficiently bright, and of a certain minimum size.

PRINCIPLES.—The size of the image depends (1) upon the size of the 'visual angle' enclosed by the two lines drawn from the extremities of the object to the 'nodal point' just behind the crystalline lens; and (2) on the distance of the nodal point from the retina, which in the normal eye is fifteen mm. The form of any letter or character is distinguished by a properly formed and healthy eye, with average light, if it subtend a visual angle of five minutes, each of its separately distinguishable parts subtending an angle of one minute. If the nodal point be more than fifteen millimètres from the retina, the image will be larger, and the acuteness of vision therefore increased; this occurs in myopia, and also when a convex glass is held in front of the eye. The reverse is true if the distance be less than fifteen mm., as in hypermetropia and when a concave glass is held before the eye. Hence convex lenses always increase, and concave lenses always diminish, the size of the retinal images. Vision or 'fixation' is called *direct* or *central* when the image of the object looked at falls on the yellow spot; *indirect* or *excentric* when, in consequence of impairment of function at the yellow spot, an image falling on some other part is better seen. The sharpness of the image depends (opacities of the media apart) upon the retina being exactly at the focus of the refracting (dioptric) media of the eye; it is also influenced somewhat by the size of the pupil, being, *cæteris paribus*, better when the pupil is small.

Normal acuteness of vision is expressed as unity (V. or S. = 1); subnormal vision being expressed as a fraction. Various *test-types* are in use, composed of letters, words, and such like, of such a size that each subtends the minimum angle of five minutes at a certain distance. The test-types of Dr. Snellen are in most general use, and include letters visible under the standard angle at from 60 metres to ·5 metre. If No. 60 be read at 60 m., then $V. = \frac{60}{60}$ or 1; if No. 60 can only be seen at 6 m., $V. = \frac{6}{60}$; &c. V., therefore, is expressed by a fraction whose numerator is the greatest distance at which a given type can be read, and the denominator the distance at which it ought to be seen; or the fraction may be reduced ($\frac{6}{60} = \frac{1}{10}$, &c.). The acuteness probably becomes somewhat lowered in some old persons without demonstrable disease.

The principal disorders of perception of form calling for description here are as follows: (1) Functional Affections of the Optic Nervous Apparatus; (2) Abnormalities of Refraction, including Hypermetropia, Myopia, and Astigmatism; (3) Anisometropia; (4) Disorders of Accommodation; and (5) Asthenopia.

1. Functional Affections of the Optic Nervous Apparatus.—Amblyopia without ophthalmoscopic changes may be permanent or temporary, and exhibit many differences in the character of the failure of sight. Many persons see much better with one eye than the other, though the defective organ shows no sign of past or present disease. Hypermetropia, or some other form of ametropia, is often present, and is usually of higher degree in the amblyopic eye. When, as is common, squint occurs in such a person, the squinting eye is almost always the defective one; and it has been assumed that the defect was a result of the squint, and due to a purposive suppression of sight in order to avoid double vision. This kind of amblyopia is, however, seen without either squint or ametropia—a fact which, with others, renders it almost certain that the defect is usually, or chiefly, congenital. Whether the seat of deficiency is in the eye or the brain remains to be proved; but it is well to realise that this form of amblyopia can seldom be improved even by long practice. In cerebral hemianæsthesia there may be blindness, or amblyopia with contraction of the field and colour-blindness, in the eye opposite to the lesion, with a lower degree of the same condition in the other eye. Some rare cases of defective sight in one eye without changes, in which there is a history of previous paralytic symptoms, probably belong to this group. In *hemiopia* (properly *hemianopsia*) there is usually loss of the corresponding (R. or L.) halves of the visual fields, vision being lost on the side opposite to the lesion. The lesion may be in the tract, but is much more often higher up (optic thalamus or occipital lobe). Sometimes there is contraction of the remaining half field. Loss of both temporal halves indicates disease at the chiasma; neither this, nor loss of both nasal halves, is frequent. In hemiopia, even of long standing, from disease above the chiasma, the optic discs are seldom altered. In some cases of 'hemiopia' only a quarter of each field is lost. Cases of hemiopia for colours without loss of light- or form-sense are occasionally met with. Disease of the optic nerve at a distance from the eye causes blindness or defective sight, often at first without any ophthalmoscopic changes; but if the defect remain, signs either of inflammation or atrophy appear in a few weeks. The ophthalmoscopic changes may, however, be very slight; as in the common cases of central amblyopia caused by tobacco-smoking, in which disease of the optic nerves has been demonstrated, and in similar cases due to other causes, especially disseminated sclerosis.

Temporary fogginess of sight, usually with the appearance of coloured rings around a candle, occurs in the premonitory stage of glaucoma; these last from half an hour to a day or more; they do not usually occur in both eyes at once (*see* EYE, AND ITS APPENDAGES, Diseases of). Attacks of megrim are often ushered in by a peculiar transient, subjective defect of sight; a small cloud, appearing near the middle of the field, quickly spreads with a quivering movement and zigzag outline over about half the field; its borders are often brilliantly coloured; it affects *both* eyes; is equally visible whether the eyes are open or shut; lasts about a quarter of an hour; and is generally followed by the other megrim symptoms to which the patient is subject. But some persons merely complain of a 'cloudiness' or of 'spots' before their headaches (*see* MEGRIM). Brief attacks of defect or blindness of *one* eye, coming on suddenly, and recurring in the same eye, occasionally take place in relation with functional headaches; and in some of these the eye eventually remains blind with the appearances of retinal embolism.

Persons who suffer from severe neuralgic pain in the fifth nerve sometimes describe dimness of the same eye during an attack, but the opportunity of verifying the statement seldom occurs. In hysterical persons sight is sometimes much lowered, and may seem altogether lost in one or both eyes. There may be photophobia, and symptoms of accommodation-spasm, and the field is, or seems to be, highly contracted. Though it may be exceedingly difficult to say that there is conscious dissimulation, the groundless nature of the ocular symptoms is sometimes proved by the fact that acuteness of vision, even in the 'blind' eye, is at once and perfectly restored by the weakest possible lens, or by a piece of flat glass mounted to resemble a trial lens. Intentionally feigned blindness of one eye can nearly always be detected by one device or another; but pretended defect of both eyes is more difficult to expose.

2. **Abnormalities of Refraction.**—SYNON.: *Ametropia.*—These conditions are of importance by preventing the formation of clear retinal images; in addition they often make the sustained use of the eyes difficult or impossible (*asthenopia*). They include (*a*) *hypermetropia,* (*b*) *myopia,* and (*c*) *astigmatism.* The varieties of asthenopia will receive a short separate account at the end of this article. As ametropic conditions are remedied by optical aids, it will be convenient first to refer to the subject of spectacles.

Spectacles.—*Varieties of Construction and Mode of Wearing.*—Refracting spectacles are made either of crown-glass or of rock-crystal. The latter is more expensive, but harder, less breakable, and rather lighter. Ordinary spectacles are biconvex or biconcave spherical lenses. Meniscus lenses are sometimes used, and are called 'periscopic,' because they give a larger field. In 'Franklin' or 'pantoscopic' spectacles the upper half is made of a different focal length from the lower; they are sometimes used by persons who need distance and reading glasses of different strengths in the same frame. The various non-refracting protective glasses (goggles, domed glasses, horseshoe or D protectors, &c.) are generally included under the term 'spectacles.' The most important points in the mounting of spectacles are that the hinges should be strong, that the sides are long enough to hold securely without uncomfortable pressure, and that the bridge should fit the nose well. The centres of the lenses should, unless otherwise ordered, be opposite the centres of the pupils when the glasses are in use. All concave glasses and convex distance glasses should sit as close to the eyes as possible; convex reading-glasses may be put farther down the nose, and shaped to allow of looking over the top of the frame in distant vision.

For 'simple' astigmatism the correcting lens is a segment of a cylinder; for 'compound' and 'mixed' cases the effect of a cylindrical and spherical lens is required, and may be obtained either by combining two suitable cylindrical curvatures at right angles to each other, or by grinding the cylinder on the flat side of a plano-convex or -concave lens; they require, of course, to be mounted with the curvature of the cylinder exactly in the right direction. When prisms are ordered they are mounted like ordinary spectacles, and a lens may be ground upon each surface of the prism if necessary; it is not practicable to wear prisms of more than about 8°. Spherical lenses can be made to act to a varying degree as prisms, by putting them with their centres nearer to or farther from each other than the pupils.

Numbering. — Spectacle lenses are at present numbered on two different systems, namely—(1) the *inch* scale; and (2) the *metrical* scale. (1) In the old system the refractive unit is a lens of 1-inch focal length, and the inch may be English, Parisian, or other. The lenses in use being all weaker than the unit are expressed by fractions; thus the strongest in use in the trial case being a 2-inch lens is expressed as $\frac{1}{2}$ (+ or −, according as it is convex or concave); a lens of 10 inches focus is $\frac{1}{10}$; and so on. It is desirable that the series of lenses should rise by equal refraction-intervals, and here the inch scale is inconvenient because it introduces difficult fractions. (2) The inch scale has largely given place to the metrical dioptric scale, in which the measure is international, the refractive unit is a weak instead of a strong lens, and the refractive intervals are equal. The unit is a lens of 1 metre (100 cm.) focal length, and is called one *dioptre* (1 D.). Stronger lenses are written as whole numbers; thus a lens four times as strong as the unit is 4 D.; a lens equal to half the unit is ·5 D. The disadvantage of the system is that the numbers do not, as on the inch system, express the focal length of the glasses; but the latter is easily arrived at by dividing 100 by the number of the lens in dioptres; thus the focal length of 5 D. $= \frac{100}{5} = 20$ cm.

To convert a lens made by the Paris inch into its equivalent in dioptres, multiply its inch-value by 36 (1 m. = 36 Paris inches nearly); thus, $\frac{1}{36} \times 36 = 1$ D. To convert a metrical lens into its equivalent in Paris inches, divide its value in D. by 36; thus 4 D. $= \frac{4}{36} = \frac{1}{9}$.

The following are the most important equivalent numbers:—

Dioptres (D.)	Focal length in Paris inches	Dioptres (D.)	Focal length in Paris inches
·5	72	4	9
	(written $\frac{1}{72}$, &c.)	4·5	8
·75	50	5	7
1	36	6	6
1·25	30	7	5½
1·5	26	9	4
2	18	11	3½
2·5	14	13	3
3	12	15	2½
3·5	10 (nearly)	18	2

Several intermediate numbers found in the trial cases have been omitted.

The several abnormalities of refraction may now be discussed in due order.

(*a*) **Hypermetropia.**—In hypermetropia the retina lies within, instead of at, the principal focus of the dioptric media. Parallel rays, such as come from very distant objects, therefore meet the retina before being focussed; and divergent rays, from near objects, meet it still more in advance of their focus. Hence the hypermetropic eye, in repose, sees nothing clearly. Distant objects can be seen clearly if, by exerting accommodation, the crystalline lens be made more convex; or if the rays, before they enter the eye, be made sufficiently convergent by passing through a suitable convex lens.

Hypermetropia, due to flatness of the posterior segment of the eyeball, *axial hypermetropia*, is always congenital; and extended observations by different authorities have shown that nearly all children are hypermetropic at birth. In sections the circular fibres of the ciliary muscle are, or appear to be, more abundant than in the normal eye. The cornea is not flatter, but the anterior chamber is rather shallower, and the pupil rather smaller than normal. In high degrees the eyeball is too small in all directions.

The natural remedy for hypermetropia consists in the exercise of accommodation for distant sight, when in the normal or emmetropic eye it is in complete abeyance. A proportionate increase of accommodation is required by the hypermetropic eye for near vision. The absolute quantity, amplitude, or range of accommodation is not greater in hypermetropic than in normal eyes; hence in hypermetropia it becomes sooner insufficient for the needs; and the higher the degree of hypermetropia the earlier does this occur.

Symptoms.—The symptoms depend on the patient's age, occupation, and health, and on the degree of hypermetropia. The lower degrees only exceptionally cause symptoms in childhood. The higher degrees in children, and the lower degrees in young adults, cause difficulty in reading, writing, or sewing, especially by artificial light, and towards the end of the day's or week's work—'accommodative asthenopia.' The difficulty is expressed in the forms of mistiness of sight, weariness or aching of the eyes, headache, sleepiness, watering, chronic congestion, and irritation of the palpebral conjunctiva. In the highest degrees the attempt to see clearly is often given up; such persons often partly compensate for the bad definition of the images by holding the book very close, and so increasing the size of the images; thus they may seem myopic. All the symptoms are worse when the health is low. As accommodation fails with age, a time arrives for every hypermetrope when, unless aided by glasses, no clear vision is possible at any distance; but spectacles are generally adopted before this occurs.

Concomitant convergent squint often arises in hypermetropia (*see* Strabismus). It is at first, and may remain, periodic, present only during strong accommodation; but often it becomes constant. In either case it may alternate, or may always affect the same eye. When constant and fixed, the sight of the squinting eye is usually found to be more or less defective, as already described. This defect is greatest in the nasal part of the visual field, which is shared with the good eye. It may be so great that only the largest objects are visible, yet the direct reflex activity of the pupil is never impaired.

When the crystalline lens is absent (*aphakia*) the eye is very hypermetropic. Distant vision is restored by means of a convex lens of 10 or 11 D. ($3\frac{3}{4}$ or $3\frac{1}{2}$ inches) held about half an inch in front of the cornea; objects at, say, 25 cm. (10 inches) are clearly seen through a lens of about 15 D. ($2\frac{1}{4}$ inches). Accommodation is abolished in the aphakic eye; but if the pupil be round and movable, its contraction aids a little in near vision, by cutting off the peripheral rays of light.

From the age of fifty-five and onwards the normal eye acquires a low degree of hypermetropia, owing to a change in the refraction of the crystalline lens.

Glaucoma is commoner in hypermetropic than in normal or myopic eyes. The habitual use of glasses by hypermetropic persons from early life may aid indirectly in preventing this disease.

Diagnosis.—The diagnosis is made subjectively by testing with glasses, or objectively by the ophthalmoscope. The former is the more generally useful. Even distant objects are seen indistinctly by the hypermetropic eye with relaxed accommodation; but they are made clear if a suitable convex lens be held in front of the cornea. (1) This test is easy to apply when the ciliary muscle is temporarily paralysed by atropine, or abolished by natural senile changes. (2) But when it is active the matter is less simple; since the old-standing habit of exerting accommodation whenever clear vision, even at a distance, is needed, in many cases inseparably connects the effort to see with the action of the ciliary muscle. Such persons cannot relax their accommodation when looking through a convex lens at a distant object. The effect of the lens is therefore added to, instead of substituted for, that of the accommodation, and distant vision made worse; no hypermetropia can be found by trial with glasses: it is entirely 'latent' (*H.l.*). (3) Between these extremes we find a large number who can partially relax their accommodation for distance in favour of a convex lens, but still use a part. They see well, or perfectly, in the distance without aid; they see equally well or better with convex lenses up to a certain strength. If now the accommodation be suspended by means of atropine we shall often find still more hypermetropia. The part that can be detected when accommodation is active is the 'manifest' (*H.m.*); the sum of the 'manifest' and the 'latent' is the 'total' (*H.*).

In testing hypermetropia, the patient being not less than three metres from the test-types, we begin with a very weak convex lens, and if vision is *not made worse*, try successively higher lenses until we reach the highest which allows the best attainable vision. This lens represents the manifest hypermetropia if accommodation be present, the total if it be absent. A stronger lens causes indistinctness by bringing the focus in front of the retina. In general the younger the patient the less is the manifest in proportion to the latent hypermetropia, even though troublesome asthenopia be present.

Hypermetropia is diagnosed by the ophthalmoscope if an erect image of the fundus is easily seen when the observer is at a distance of eighteen inches or more from the patient. The image is seen equally well when the observer comes as close as possible to the patient; and if he possess a 'refraction' ophthalmoscope, he can *in this position* measure the degree of hypermetropia by finding the strongest convex lens through which the details of the fundus still look perfectly clear. In this test the accommodation of both persons must be fully relaxed; the observer has to learn to do this, but the patient generally relaxes his ciliary muscle at once in the dark room, even though he could not do so when tried with glasses for the distant types.

Another test, *retinoscopy*, is based on the fact that when light is thrown by the ophthalmoscope into the eye at a distance of three or four feet, slight rotation of the mirror causes a shadow to move across the illuminated field; in hypermetropia the shadow moves in the opposite direction to the rotation of the *concave* mirror. The method is very useful, especially for young patients; and in skilled hands it is expeditious and very accurate.

The optic disc in hypermetropia, especially in children, often seems, and sometimes is, hazy, and is sometimes too red; and the retinal arteries are often too tortuous.

Treatment.—Treatment is necessary for hypermetropia whenever there is asthenopia, and when strabismus has arisen. Convex spectacles are ordered which, according to circumstances, neutralise a part or all of the hypermetropia; and are worn constantly, or only for near work. Periodic squint may always be cured by the constant use of fully correcting glasses; but in most cases where it has become constant, an operation is necessary (*see* Strabismus). In children with asthenopia it is usually best to order glasses for constant use, which correct almost the whole hypermetropia; but if the symptoms are in connexion with weak health and the hypermetropia be slight, the temporary use of glasses for near work alone is enough. Young adults using glasses for the first time are often satisfied with those which neutralise only the manifest hypermetropia, using them for all near work; but after some weeks or months asthenopic symptoms often recur, we find that there is more manifest hypermetropia than before, and we are obliged to order stronger glasses. But ophthalmoscopic estimation will, as stated above, generally tell us correctly almost the total even at the first examination; and when this method makes it clear that the total is much greater than the manifest hypermetropia, glasses of nearly the full strength should be ordered at once. On theoretical grounds it is undoubtedly best for glasses to be worn constantly by hypermetropes, so that the accommodation may always be at rest. But a good deal of latitude must be allowed to grown-up, and especially elderly, patients in regard to wearing them for distance, unless there be constant asthenopia.

Acuteness of sight is usually normal in corrected hypermetropia. In many cases of high degree, where vision is, both with and without glasses, subnormal, some astigmatism is also present; but cases occur where the defect cannot be thus accounted for, and it is then assumed to be due to defective development of eye or visual centre. But probably want of education of the retina in the perception of clear images in a great degree accounts for the phenomenon.

(*b*) **Myopia.**—In myopia the retina lies beyond the principal focus of the dioptric media, generally on account of lengthening of the posterior part of the eye—*axial myopia.* It is consequently at the conjugate focus of a point at some definite distance in front of the eye, which indeed is the 'far-point,' or greatest distance of distinct vision of the eye in question. The greater the elongation of the eye, the nearer is the 'far-point,' the 'shorter' the sight, or the higher the degree of myopia. By using accommodation objects can be seen at a still shorter distance.

Ætiology.—Myopia is comparatively seldom present at birth. The elongation usually comes on between about seven and fifteen years of age, progresses for a time, and stops between puberty and adult age; but in some cases the stretching (and its attendant structural change) persistently increases through life, and leads to serious and even disastrous consequences. Myopia is often hereditary, and inheritance doubtless accounts entirely for some very severe cases where no other causes have operated. But habitual use of the eyes upon close work, especially in a stooping posture, aids very strongly in its production. Any severe or lasting ill-health may determine the onset or increase of serious myopia in a predisposed person.

Myopia may also be caused by increased

curvature of the cornea after keratitis, and is an invariable result of 'conical cornea.' Certain changes in the lens in the early stages of senile cataract sometimes produce myopia, even of considerable degree; but this form of myopia does not, as axial myopia may, indicate degeneracy of the deeper tissues, and hence does not influence the question of operation.

Anatomical Characters.—The elongation occurs chiefly in the posterior part of the eye, and especially at the yellow-spot region. The sclerotic and choroid are thinned in proportion to the distension, and the choroid often locally atrophied; the term 'posterior staphyloma' is given to the bulging region. In high degrees the eye is enlarged, and its coats are thinned, in all directions. The term, 'sclerotico-choroiditis posterior' is also used to indicate the supposed nature of the change. In high degrees, particularly late in life, the vitreous often becomes fluid and contains opacities; hæmorrhages may occur from the choroid; and there is a strong predisposition to detachment of the retina and to incomplete cataract. In the ciliary muscle of myopic eyes the circular fibres are deficient or wanting. The anterior chamber is often deeper, and the pupil larger than usual. Owing to their large size, highly myopic eyes are often prominent; and from the same cause their movements are less free, and are apt to cause muscular fatigue.

Symptoms.—A low degree of stationary myopia usually causes no inconvenience. In the higher degrees advice is sought, either because distant sight is bad or near work has to be held inconveniently close; or on account of eye-ache, headache, watering, photophobia, or dimness; or for inefficiency of the internal recti (muscular asthenopia), or actual divergent squint. In the highest degrees divergent squint is nearly always present at the natural distance of distinct vision, and possibly even for distance; and in much lower degrees there is often difficulty in keeping up convergence, and consequent pain and weariness. Aching frequently shows that the myopia is increasing; it is always made worse by use of the eyes, but is often present even when at rest in bed; it may accompany the development of a squint, or of detachment of the retina. Myopic eyes, even of low grade, are often intolerant of bright light. Acuteness of vision is frequently sub-normal in high degrees, especially in old people; such defect, when not accounted for by visible structural changes, is assigned to congestion of the choroid.

Diagnosis.—A myopic person with healthy eyes can read the smallest print fluently at his own 'far-point,' but not farther. He gains perfect distant vision by looking through a concave lens, which gives to rays of light from distant objects a divergent direction, as if they came from his natural 'far-point.' Placing him not less than ten feet from the test-types we find experimentally the *weakest* concave lens that gives the best attainable vision. A stronger lens over-corrects the myopia, producing hypermetropia, which, in its turn, is corrected by the exercise of accommodation.

Myopia is diagnosed objectively as follows: (1) When, by direct ophthalmoscopic examination at a long distance, an image of the fundus is seen, which, on the observer moving his head from side to side, seems to move in the opposite direction. This image disappears when the observer comes near to the eye examined. (2) When by direct examination close to the patient, a clear image (erect) can be obtained only by placing a concave lens behind the mirror; the *weakest* lens which gives a clear image being the measure of the myopia. (3) When by indirect examination the size of the ophthalmoscopic image increases on withdrawing the objective lens from the patient's eye. (4) When by retinoscopy with the *concave* mirror, the shadow moves in the same direction as the rotation of the mirror.

The ophthalmoscopic changes depend chiefly on the atrophy of the choroid, which so often takes place on some part of the staphylomatous area. The commonest change is the 'myopic crescent,' a patch of yellowish-white colour (exposed sclerotic), due to atrophy of the choroid at the true outer border of the optic disc. It is sometimes seen in eyes not myopic. When more advanced it extends all round the disc (annular staphyloma). There may also be areas of atrophy with signs of past or present inflammation, at the yellow spot. In high myopia with abrupt bulging of the tunics, the disc is often tilted and then looks oval, and its outer side often becomes pale.

Course and Prognosis.—Axial myopia cannot diminish. Though its increase as a rule ceases about the same time as the cessation of the bodily growth, it may continue, or may take a fresh start later in life, especially if the health be bad or the eyes be excessively used for fine work. But often its course seems to depend upon causes which are not under direct control; for we see myopia of high degree, leading to disastrous results, or blindness, in persons who have never learnt their alphabet, or strained their eyes in any way; and, on the other hand, it is common to meet with very myopic people, of studious habits and advanced age, in whom the eyes have not changed since youth. In general the prognosis is worse the higher the degree, the older the patient, and the feebler the health.

Treatment.—Much may doubtless be gradually done to prevent the acquisition and transmission of myopia, by improvements in the lighting of schoolrooms, and construction of seats and desks, and by the choice of well-printed books. During the progress of myopia the time given to school-work should, whenever possible, be shortened; and if the disorder be quickly increasing, or if there be much aching or irritation, rest of the eye should be insisted upon for several months, or longer. Myopic children should use their eyes only as much as is comfortable, and should be forbidden to read fine print, to read by bad light, or to stoop. If there be severe aching and intolerance of light, or rapid increase of the myopia, especially with diminished acuteness of sight, prolonged rest, subdued light (or smoked glasses), and the use of the artificial leech at intervals of a few days, with derivative treatment, are of service, at least in relieving the symptoms and improving vision for a time.

The corrective treatment consists in the use of concave glasses. Myopic children should as a rule wear glasses for distance merely on educational grounds. These glasses may fully correct the defect, but it is better that they should be a little under than over the full strength. If there be muscular asthenopia, the glasses often cannot be continuously worn, unless treatment be also directed to the internal recti. Adults may use their own judgment as to wearing distance-glasses. Except in low degrees of myopia it is best not to encourage fully correcting glasses for near work, because they cause full action of the hitherto little exercised accommodation, and also derange the relation between accommodation and convergence, and are thus likely to tire the eyes; they also cause difficulty by diminishing the retinal images; if their use be persisted in for reading, or other purposes, when they cause discomfort, they may act indirectly in increasing the myopia. When the natural far-point in myopia is not nearer than 13 inches (33 cm.) reading glasses are seldom required. But for higher degrees it is often necessary to order spectacles which partly correct the myopia, that is, make the eyes less myopic, and thus remove the far-point farther off, and allow the patient to read, or use them in other ways, without stooping. As a general rule, subject to the peculiarities and needs of each case, about half the full correction may for this purpose be safely and comfortably used. For music or painting a rather stronger pair of spectacles are sometimes required. When there is muscular asthenopia, shown by the fact that in near vision one eye, if covered, deviates outwards, relief may sometimes be given by combining with the reading glasses prisms with their bases inwards; the prisms, by allowing the convergence to be lessened, relieve the internal recti.

(*c*) **Astigmatism.**—Astigmatism may be either *regular* or *irregular*. *Regular* astigmatism depends upon the refracting surfaces of the eye, chiefly of the cornea, not being spherical, but having different curvatures, that is, focal lengths, in different meridians, the meridians of greatest and least curvatures ('chief' or 'principal' meridians) being always at right angles to each other, and the others having regularly intermediate curvatures. The meridian of greatest curvature of the cornea is generally vertical or nearly so. The astigmatism of the lens, though less regular than that of the cornea, tends to correct the latter. In 'simple' astigmatism one chief meridian is normal, the other either myopic or hypermetropic; when 'compound' both chief meridians are myopic, or both hypermetropic, but in different degrees; when 'mixed,' the eye is hypermetropic in one chief meridian, and myopic in the other. When the focal difference between the chief meridians, *i.e.* the degree of astigmatism, is not greater than is represented by a lens of 72 inches focus (·5 D.) it may generally be neglected; even much higher degrees often cause no trouble.

Astigmatism is to be suspected in all cases of ametropia where spherical lenses do not raise vision to the normal, no other cause of the defect being found. It is detected subjectively by numerous tests, most of which consist essentially of straight lines running in various directions, some of the lines being seen by the astigmatic eye better than others. It can also be detected and measured by the ophthalmoscope and by retinoscopy.

TREATMENT.—Astigmatism is corrected by cylindrical lenses, which neutralise the difference of refraction of the two chief meridians; but in the higher degrees acuteness of vision often remains even then subnormal. *Irregular* astigmatism can seldom be remedied.

3. **Anisometropia.**—This signifies different refraction in the two eyes, and is a very common condition, the difference sometimes being extreme. When one eye is normal and the other myopic, each may be, and often is, used for vision at different distances, and each remains perfect; but if one be astigmatic, or very hypermetropic, it is generally defective.

When slight, this condition may be neutralised by corresponding spectacles, but when the inequality is great, fully correcting glasses cause so much difference in the size of the images in the two eyes, that equalisation is seldom possible. But it should be attempted when there is any tendency to squint, in order to encourage binocular vision.

Effect of blindness of one eye.—Acuteness of sight is always rather better with both eyes than with either alone; further, both eyes are necessary for the appreciation of solidity and distance. Patients often think that blindness or disuse of one eye throws 'double work' upon the other and 'weakens it.' Nearly always, however, in such a case some other cause can be found for the asthenopia of the sound eye.

4. Disorders of Accommodation.—(*a*) **Presbyopia.** — The 'amplitude' or 'range' of accommodation is expressed by the difference between the greatest distance, 'far-point,' (*r*), and the least distance, 'near-point,' (*p*), of distinct vision. Age for age, it is nearly equal in all eyes, whatever their refraction. Its natural failure with age causes presbyopia, the onset of which has been arbitrarily fixed to begin, in the emmetropic eye, at the age of about 40 to 45, when the near-point is at nine inches (22 cm.); and the failure generally progresses at a constant rate. Presbyopia is corrected by the convex lens, which enables the patient to read at nine inches; the strength of this lens varies inversely as the amplitude of accommodation; and at the age of 65, the near-point being removed to infinity, the correcting lens is one of nine inches focus.

Symptoms.—Presbyopia is first shown by difficulty in reading or sewing by artificial light, or in the train or carriage; defective accommodation prevents the work being held close enough to compensate for the defective light or for the shaking, and to remedy the former the candle is often placed between the eyes and the book. When more advanced, the patient becomes 'long-sighted,' and has to put his book at arm's length unless he wear glasses. If the refraction is normal, distant sight is perfect. In hypermetropia, presbyopia begins at an earlier age, less accommodation being available for near vision; and in myopia it sets in later because less accommodation is needed for seeing at a given distance. Hence a low degree of myopia is an advantage. When the far-point in myopia is at or within nine inches (22 cm.) presbyopia does not occur.

Diagnosis.—Presbyopia is to be distinguished from loss of accommodation due to paralysis of the ciliary nerves, and from failure due to feeble health or other causes, both of which may occur at any age. True presbyopia, however, sometimes occurs earlier and progresses more quickly than usual, especially in eyes which are threatened with glaucoma.

Treatment.—The treatment of presbyopia consists in ordering convex glasses which enable the patient to read at nine inches or a greater distance. Most people prefer glasses which enable them to read easily at twelve or fifteen inches, and with which reading at the standard nine inches is possible only for a very short time, if at all. The smaller the quantity of accommodation remaining, the less is the range of clear vision; and if accommodation is abolished, clear sight is possible only when the object is at the focus of the glasses. Hence the increase of strength of the glasses which becomes necessary as age advances should be made gradually, that the patient may grow accustomed to the loss of range, and to the necessity for keeping his book more and more at an unvarying distance. As the book has to be placed nearer by artificial than by day light, it is generally best to have a rather stronger pair of glasses for evening use than for the daytime. The following table, giving the strength of the glass necessary to bring the near-point to nine inches (22 cm.), at various ages, serves as a useful basis for the selection of spectacles for presbyopia in emmetropic persons:—

Age	Glass required to bring '*p*' to 9 in. (22 cm.)		
40	0		
45	$+\frac{1}{36}$ inch	=	+1 dioptre.
50	$\frac{1}{18}$,,	=	2 ,,
55	$\frac{1}{12}$,,	=	3 ,,
60	$\frac{1}{9}$,,	=	4 ,,
65	$\frac{1}{8}$,,	=	4·5 ,,
70	1-6½ ,,	=	5·5 ,,

(*b*) **Paralysis of accommodation.** — Synon.: *Cycloplegia.*—Paralysis of the ciliary muscle occurs in paralysis of the whole third nerve. But it may occur without affection of the extrinsic muscles of the eyeball. In these cases it is generally combined with paralysis, more or less complete, of the iris (*ophthalmoplegia interna*); but it may be present as an isolated symptom, the pupils being normal, and of this the commonest example is post-diphtheritic cycloplegia. The failure of accommodation in glaucoma may be accounted for in acute cases by compression of the ciliary nerves, but in old cases is doubtless due to the atrophy of the ciliary muscle which always exists. Cycloplegia, usually with some affection of the iris, is a common result of blows on the eye; sometimes recoverable, it is, however, often permanent. Lowered endurance of sight, pain, and sudden temporary failures of accommodation, are amongst the most important phenomena of sympathetic irritation.

(*c*) **Spasm of accommodation.**—Temporary spasmodic action of the ciliary muscle, often exceeding the necessary amount, frequently occurs in hypermetropia, with each effort to see clearly; it usually ceases at once on going into a dark room. In low myopia with irritative symptoms, the ciliary muscle often acts unnecessarily; and such spasm, when persistent, is probably one cause of further elongation of the eye. Spasm of accommodation also occurs in some functional and hysterical affections of the eyes, with other symptoms of ocular irritation. The function of accommodation is closely associated with that of convergence, although the two can be exerted separately to a limited extent. The accommodation of one eye cannot be exercised without, and scarcely in any different degree from, that of the other; but it is probable that different parts of either ciliary muscle can act in different degrees and thus to some extent correct astigmatism.

(*d*) **Micropsia.**—Definition.—Any condition of sight in which objects seem lessened in size, without diminution in the size of the retinal images. This indicates either an extreme effort of accommodation, and may be thus complained of when this function is weakened; or disease of the deep layers of the retina.

5. **Asthenopia.**—Asthenopia is any condition in which the eyes cannot be used for long without fatigue, pain, or other symptoms.

Muscular asthenopia is caused by difficulty in maintaining the convergence of the visual lines, and is commonest in myopia, though it is often seen with normal refraction, especially in youths and young adults. It causes, besides aching of the eyes, 'confusion' of the print, and sometimes double vision. In slight cases, accompanying myopia, partially neutralising concave glasses, which enable the book to be held at a greater distance, will often give relief. In a few cases, with or without myopia, spectacles, consisting of prisms with their bases inwards, are of service, by lessening the convergence necessary for vision at a given distance. In high degrees, tenotomy of the external rectus is called for (*see* Strabismus). Asthenopia may also be caused by slight vertical deviations (upward or downward) of one eye.

Asthenopia from deficient accommodation is also shown by inability to read for long, but there is no 'moving' or 'dancing' of the letters, nor any diplopia. The object simply becomes 'misty' or 'the sight goes' for a time, returning when the eyes are rested for a few minutes; or the eyes feel tired and hot, and ache. Headache and occasionally even vomiting may follow neglect of such symptoms. It is commonest in hypermetropia (asthenopia from excessive demand on accommodation); but is also seen in emmetropic, and even in slightly myopic eyes, if the tone of the ciliary muscle is low (asthenopia from weakness of accommodation). Asthenopic symptoms are not common in presbyopia.

Neurasthenic Asthenopia.—All causes of asthenopia are more effective in neurasthenic persons, and some of the worst cases are in those who have good range of accommodation, and no ametropia. Sensitiveness of lids, eyeball, and perhaps retina, may have been left by previous styes, phlyctenulæ, or follicular granulations, and the onset of symptoms often dates from some piece of eye-work requiring strenuous effort; but serious breakdown of the eyes seldom occurs unless the general conditions of neurasthenia — excitability without staying power — are present.

Retinal Asthenopia.—Functional exhaustion of the retina or optic nerve is sometimes seen in optic neuritis, and other diseases of the optic nerve; sight being good, but becoming duller after a short period of use. It is not, on the whole, an important diagnostic symptom.

E. Nettleship.

VIS MEDICATRIX NATURÆ

(Lat.).—An expression formerly much used to indicate the innate power possessed by Nature of healing or curing disease. *See* Disease, Treatment of; and Therapeutics.

VITAL STATISTICS.

—For the purposes of public health, vital statistics are concerned mainly with the incidence of disease and death upon communities and upon different fractions of communities, and with the renewing of population by births. Such statistics may be regarded from several points of view. It may be desired to investigate the average incidence of a certain disease, or a group of diseases, upon different populations or different sections of a population; sections marked out by race, locality, occupation, class, age, sex, or other selected characteristic. Or, again, one disease may be compared with another as to incidence upon the same population. From yet another standpoint, inquiry may be made into the changing incidence of a given disease upon a given population in the course of time, the change being perhaps progressive, perhaps fluctuating at long or short intervals, regular or irregular. Thus comparison may be made between the various seasons of the year, between one year and another, or among the averages of terms of years; and the change may prove to be one of quantity, or quality, or both. By patient record and analysis of the available data, it becomes possible to learn *how*, *when*, *where*, and *whom* a given disease attacks, and hence to obtain a clue to the further problem *why* it attacks, and even to the most important matter of all, the means of prevention.

The materials necessary for such research include, on the one hand, records of births, deaths, and sickness; and, on the other hand, accurate information as to the population among which the events so recorded have happened.

Population.—A census in this country is taken at the end of the first quarter of the first year in each decade. Between these widely distant known points, estimates can be made on the assumption that the rate of increase is uniform. Thus, if P and P' be the numbers enumerated in 1881 and 1891 respectively, the rate of increase in ten years is $\frac{P'}{P}$, in one year therefore $\sqrt[10]{\frac{P'}{P}}$, in a quarter of a year $\sqrt[40]{\frac{P'}{P}}$. For the sake of brevity we may denote the rate of annual increase, that is $\sqrt[10]{\frac{P'}{P}}$, by r, and the quarterly rate by $\sqrt[4]{r}$. Then the estimate at the end of the first quarter of 1882, one year after the census, will be $P \times r$, in two years $P \times r \times r$ ($= Pr^2$), in three years Pr^3, and so on, year by year, till we come to $P \times r^{10}$, which is of course equal to P'. But the mid-year population, which is always adopted as the basis of birth-rates and death-rates, will be in advance of these estimates by one quarter's growth: $P \times \sqrt[4]{r}$ in 1881, $P \times r \times \sqrt[4]{r}$ in 1882, $Pr^2 \times \sqrt[4]{r}$ in 1883.

Further than this, it is assumed that the population P' of 1891 goes on increasing at exactly the same rate as the population P of 1881 was found to have done; the estimates for the years after 1891 are made upon the old data, until the next census again gives certainty. The estimate for the mid-year 1891 is $P' \times \sqrt[4]{r}$, for 1892 $P' \times r \times \sqrt[4]{r}$, for 1893 $P'r^2 \times \sqrt[4]{r}$.

In practice, the values of P and P' are of course known from the census returns, and the use of logarithms makes the calculations perfectly simple. A rougher method, sufficiently accurate for small populations, is to assume that the increment in every year is one-tenth of that recorded in the ten years, and to add $\frac{P'-P}{10}$ for each year. It is obvious that the result will only be accurate about the middle of the decade, the increment being overstated during the first half, and understated during the second; for, as the population is increasing, $\frac{P'-P}{10}$ bears a higher ratio to P than it does to P', so that the increment in 1881 is made to be *relatively* larger than that in 1891, although by hypothesis the rate of growth ought to remain unchanged.

Sometimes the estimate is based upon other data altogether, by adding to the last census-population the so-called 'natural increase,' that is, the excess of births over deaths, it being assumed that there is no gain or loss from other sources, or that these balance each other. Experience has shown that while mathematical estimates are tolerably correct for very large mixed populations, such as a whole nation, they are liable to error in proportion to the smallness of the numbers concerned. In towns the growth is chiefly marginal, the central portion being capable of little increase; and the growth, even if continued uniformly, may be outside the more or less arbitrary limits of the area under consideration. Fluctuations of trade are of great moment as affecting local immigration and emigration. In many instances the 1891 estimates, based upon the 1871 and 1881 census, were proved by the new census of 1891 to be far wide of the mark. Liverpool, instead of increasing as had been supposed, was found to have actually decreased, and the population was over-estimated by 20 per cent. Salford was over-estimated by 27 per cent., and Newcastle under-estimated by 11 per cent. For at least five years out of every decade local birth-rates and death-rates are liable to serious error, although their unreliability will usually be made known either by persistent abnormality of the rates themselves, or by the discrepant results of local observations, such as influx or efflux of artisan population, records of school attendance, inhabited houses, &c.

For many statistical purposes, much further detail is required. It is necessary to know how many there are of each sex, of each group of ages, or of each occupation, for the tendency to sickness and death varies greatly, and rates may need to be calculated separately for each class.

Births and Deaths.—Births must be registered within six weeks, and deaths within five days, of their occurrence. These form the basis of the national statistics of births and deaths. As regards the latter, the record includes not only the time and place of death, but also the age, sex, and place of residence of the deceased, the causes (primary and secondary) of death, and their duration. The age to be given is that attained at the last birthday; if less than one year it should be stated in months, weeks, days, or hours. In compiling statistics of deaths from different causes only one cause can be accepted for each death, and when two or more are recorded it is usual to give precedence to 'zymotic' diseases over all others, to 'specific' over non-specific, and to 'primary' over 'secondary' causes. Where these criteria are indecisive, priority may be given to the cause mentioned first in the certificate. 'Uncertified' deaths, in which no certificate is given either by a registered medical practitioner or by a coroner, were in 1891 2·7 per cent. of the total number, but the proportion ranged from 0·7 per cent. in Middlesex to 6·2 in Huntingdonshire. A large proportion of deaths (in towns not often less than 10 per cent., and in London as many as 25 per cent.) take place in public institutions such as hospitals, asylums, and workhouses. These ought to be credited to the locality of former residence, which may or may not be the same as that in which the institution is situated, and in which, therefore, the deaths are registered.

Still-births are not registered in this country; they are estimated to be equal to about 4 per cent. of the live-births. Of the latter about 5 per cent. are illegitimate, the proportion being greater in rural than in urban communities, and declining in England generally. About 104 males are born for every 100 females, but owing to the higher death-rate among male infants the female population exceeds the male in the second year of life and at all later ages.

Rates.—Statistics of births and deaths have to be considered with reference, first, to the magnitude of the population concerned, and, secondly, to the length of time covered by the record. It is convenient to adopt fixed standards of population and time, and birth-rates and death-rates are usually stated 'per thousand per annum,' that is, as the number of such events among each thousand of the population in the course of a year. The true (astronomical) year has 365·24 days, while the statistics of births or deaths will usually be those of 364 days (52 weeks) or 365 days. Hence an adjustment becomes necessary if great accuracy be desired. Thus, if the records of a 'year' of 52 weeks give a death-rate of 20·0 per 1,000 per annum, the true death-rate will be $20{\cdot}0 \times \frac{365{\cdot}24}{364}$, or 20·07. Similarly, birth-rates and death-rates for fractions of a year are stated as *annual* rates; they are the annual rates which would be attained if the conditions observed during the period in question were continued unchanged for a whole year. In general terms, if *n* be the number of days during which events are recorded, the rate per 1,000 per annum will be

$$\frac{\text{No. of events recorded during } n}{\text{Population at middle of year}} \times \frac{365{\cdot}24}{n} \times 1{,}000.$$

Thus, if there be 40 deaths in a given week in a population of 100,000, the death-rate for that week is $\frac{40}{100{,}000} \times \frac{365{\cdot}24}{7} \times 1000$, that is, 20·9 per thousand per annum.

The population must of course be that in which the events happen, neither more nor less. To find the death-rate at ages between 10 and 15 years, for instance, we must take as our basis, not the whole population, but merely the number of persons living at those ages; the deaths at ages 10 to 15 years must be compared with the population at ages 10 to 15 years.

Birth-rate.—The English birth-rate has declined steadily from 36·3 in 1876 to 30·2 in 1890, the first break of any moment being a slight rise to 31·4 in 1891. It is highest in districts containing the largest proportion of young married people, and high, therefore, in towns which are rapidly growing by influx of young adult persons. In mining districts, local birth-rates of 40 or 50 are not uncommon. Although birth-rates are always calculated on the whole population regardless of age or sex, it ought to be remembered that the population more immediately concerned is that of married women under 45 years of age, and that a community containing an unusually large or unusually small proportion of such persons may be expected to have a correspondingly abnormal birth-rate.

Death-rate.—Death-rates may be calculated for a community as a whole, or for a particular class or section of a community; and with regard to deaths from all causes, or deaths from one cause or group of causes only.

The English death-rate has materially declined during the last twenty years, and, on the whole, more rapidly among females than among males.

Years	Mean Annual Death-rates in		
	Both Sexes	Males	Females
1841–50	22·4	23·1	21·6
1851–60	22·2	23·1	21·4
1861–70	22·5	23·7	21·4
1871–80	21·4	22·7	20·1
1881–90	19·1	20·3	18·1
1888	18·1	19·2	17·0
1889	18·2	19·3	17·2
1890	19·5	20·8	18·3
1891	20·2	21·5	19·0

The decline has not been free from interruptions, and, indeed, after reaching a minimum in 1888, it steadily increased during the next three years, as the table shows.

In infancy and in old age the tendency to death is high, the minimum being at ages between 10 and 15 years. The following table gives the mean annual rates in England and Wales for the decades 1861–70 and 1871-80.

Ages	Both Sexes		Males		Females	
	1861–70	1871–80	1861–70	1871–80	1861–70	1871–80
0–5	68·3	63·1	73·2	68·1	63·4	58·1
5–10	8·0	6·4	8·1	6·7	7·8	6·2
10–15	4·5	3·7	4·5	3·7	4·5	3·7
15–20	6·4	5·3	6·2	5·2	6·6	5·4
20–25	8·2	7·0	8·5	7·3	8·0	6·8
25–35	9·8	8·9	9·9	9·3	9·7	8·6
35–45	12·7	12·6	13·5	13·7	12·0	11·6
45–55	17·3	17·7	19·2	20·0	15·6	15·6
55–65	30·3	31·5	33·0	34·8	27·8	28·5
65–75	62·5	64·9	66·7	69·6	58·8	60·8
Over 75	158·8	161·6	164·6	169·1	154·3	155·8
All ages	22·5	21·4	23·7	22·7	21·4	20·1

The comparison of these two decades shows that in both the death-rate was lower among females than among males, not only at all ages taken together, but also at each group of ages separately, except in the second decade of life. It shows, too, that while the general death-rate had, on the whole, declined in both sexes, the decline was limited to the ages below thirty-five years in males, and below forty-five years in females; beyond those points it actually increased. These observations are confirmed by the statistics of the decade 1881–90, not yet officially tabulated in the same way.

It is usual to state the 'infant mortality' in a different way, taking advantage of the accurate statistics of births as a basis of population, and thus avoiding the uncertainty of estimates. The infant mortality is therefore

$$\frac{\text{No. of deaths under one year}}{\text{No. of births during year}} \times 1{,}000.$$

It is not comparable with death-rates at other ages, for it is not calculated upon a mean population. It is higher in towns than in the country, and among males than among females. For the decade 1871–80 the mean infant mortality was 149—that of males being 163 and females 134. It declined to 142 in the decade 1881–90, but has fluctuated considerably in recent years, and in 1891 was 149.

Notwithstanding the high mortality among infants, a high birth-rate does not usually carry with it a high general death-rate, but rather the reverse. It implies a large proportion of young adults in the population as parents, and also a large proportion of children who have passed the period of early infancy. Among these groups the death-rate is low, as is evident from the foregoing table, and the excess of infant population is more than compensated for by the excess at ages of low mortality.

The age-constitution of the population ought always to be borne in mind as a possible source of fallacy in comparing crude death-rates. Extreme instances are met with in dealing with selected populations—for example, the public services. The death-rate among soldiers stationed in the United Kingdom was 9·1 during the decade 1871–80. In order to form an opinion whether this rate is high or low, comparison must be made with the standard death-rate among males of army ages, and not with that of a community containing women, children, and old people. Reference has already been made to the differences in age-constitution between urban and rural communities, and between one town and another. From census data the Registrar-General has worked out for each of the large towns in England a 'factor,' or number, by which the crude death-rate may be multiplied if it be desired to nullify the effect of a local age and sex distribution, differing from that of the country at large. The 'corrected death-rate' so obtained represents that which would prevail under local conditions if the local population had the same composition, as regards age and sex, as that of the kingdom as a whole. For the decade 1871–80 the 'factors' ranged from 0·9565 (Norwich) to 1·1143 (Manchester). The crude death-rates for these two towns in 1883 were 19·64 and 27·64 respectively, the corrected death-rates 18·79 and 30·80, so that when compared on equal terms the difference is increased. Rural districts usually contain an unduly large proportion of young and old persons, with comparatively few young adults, and the factor for correction would (as in Norwich) be less than unity; but most towns resemble Manchester in having an excess at those ages at which mortality ought to be low, and the factor in all such cases would be greater than unity. Corrected death-rates enable us to compare the mortality of different towns upon equal terms, and the comparison is further facilitated by calling the death-rate of the whole country 1,000, and stating the corrected death-rate of each town in terms of this, according to the following formula:—

$$\text{'Comparative mortality figure'} = \frac{\text{Corrected local death-rate}}{\text{Death-rate of whole country}} \times 1{,}000.$$

Life-Tables.—The death-toll at each age being known, it is possible to construct a life-table—that is, to estimate the gradually diminishing number who would survive at the end of each successive age-period, out of, say, a million born.

	Males				Females			
	Survivors out of a million born		Expectation of life		Survivors out of a million born		Expectation of life	
Age	1838–54	1871–80	1838–54	1871–80	1838–54	1871–80	1838–54	1871–80
0	1,000,000	1,000,000	39·9	41·4	1,000,000	1,000,000	41·9	44·6
10	689,857	708,990	47·1	47·6	715,769	738,382	47·7	49·8
20	651,903	680,033	39·5	39·4	674,119	707,949	40·3	41·7
30	595,089	630,038	32·8	32·1	612,774	658,418	33·8	34·4
40	531,657	563,077	26·1	25·3	545,844	596,113	27·3	27·5
50	455,727	476,980	19·5	18·9	473,245	520,901	20·8	20·7
60	356,330	365,011	13·5	13·1	383,974	422,835	14·3	14·2
70	223,490	222,056	8·5	8·3	253,161	277,225	9·0	9·0
80	80,343	77,354	4·9	4·8	100,394	108,935	5·3	5·2
90	9,321	8,015	2·8	2·7	13,802	14,225	3·0	2·9
100	154	82	1·7	1·6	295	225	1·8	1·6

The above data are taken from life-tables constructed by Dr. Farr (1838–54) and Dr. Ogle (1871–80). The chance of survival at each age and in both tables is greater among females than among males. The 1871–80 table shows a greater number of survivors than the other at every age up to sixty-seven in males, and ninety-two in females.

The calculation may be carried a step farther, and an estimate made of the 'expectation of life' at each age—that is, of the average number of years which persons who have reached that age will live. It has already been stated that while the death-rate as a whole is decreasing, it is increasing at ages above thirty-five years in males, and forty-five years in females. Accordingly, we find on comparing the two life-tables, that while the expectation of life is much greater under the new table than under the old at all early ages, it is actually less at ages over nineteen years in males, and over forty-five in females. The expectation at birth is also termed the 'mean duration of life,' and at later ages the 'mean after-lifetime.' Owing to the high death-rate among young children, the expectation is greater at four years of age than it is at birth; thenceforward it declines uninterruptedly. The detailed 1871–80 life-table shows that out of a given number of males born, exactly half survive at forty-seven years of age; and this has been termed the 'probable duration of life.' For females it is fifty-two years.

Causes of Death.—So far only total death-rates have been considered, without distinction of cause. If the incidence of the general death-rate upon different ages and sexes is unequal, that of single diseases or natural groups of diseases is still more so. Each disease has its characteristic curve of age-mortality; and for obvious reasons this curve is almost always more intense than that of the general death-rate. Thus whooping-cough and measles kill few except in early childhood, while cancer kills few except in later adult life, and phthisis is most destructive in early adult life.

Mean Annual Death-Rates, 1871–1880.—*England and Wales.*

Ages	Small-pox	Measles	Scarlet Fever	Enteric Fever	Whooping cough	Diphtheria	Diarrhœa	Cancer	Phthisis	Heart Disease, &c.	Respiratory Diseases	Urinary Diseases
0–5	·53	2·57	3·49	·40	3·65	·47	5·73	·01	·77	·09	12·20	·15
5–10	·28	·21	1·52	·34	·14	·29	·07	·01	·36	·14	·56	·09
10–15	·14	·02	·33	·31	·01	·09	·02	·01	·66	·24	·20	·07
15–20	·20	·01	·10	·41	·00	·03	·02	·02	2·04	·30	·30	·10
20–25	·30	·01	·06	·38	·00	·02	·04	·03	3·12	·34	·45	·15
25–35	·24	·01	·05	·29	·00	·02	·06	·13	3·62	·62	·78	·25
35–45	·17	·00	·02	·25	·00	·02	·10	·53	3·75	1·31	1·62	·43
45–55	·11	·00	·01	·25	·00	·01	·16	1·26	3·13	2·27	3·26	·66
55–65	·07	·00	·01	·27	·00	·02	·41	2·21	2·45	4·81	7·43	1·20
65–75	·05	·00	·00	·29	·00	·02	1·19	3·12	1·48	9·48	16·08	2·21
Over 75	·04	·00	·00	·22	·00	·01	3·51	3·33	·49	12·09	30·24	3·31

As regards sex, similar disproportion may be met with. The majority of diseases cause a higher mortality among males, the principal exceptions being diphtheria, whooping-cough, cancer, and, of course, the diseases connected with parturition. Cancer is nearly twice as common among females as among males, while in deaths from violence there is a still greater inequality in the opposite direction. These are extreme instances; but in comparing different local or specialised death-rates with each other or with a standard, it is necessary to bear in mind that the comparison is only legitimate on the assumption that there is no *material* difference with regard to age and sex constitution.

The table opposite shows the progressive changes during the last thirty years in the mortality attributed to certain causes.

The possibility of altered nomenclature of disease, as well as altered environment, must be taken into account in interpreting these changes; and as regards some of the zymotic diseases, the occurrence of epidemic variations in quantity and quality, at long or

Mean Annual Death-Rates.—England and Wales.

—	1861–70	1871–80	1881–90
Small-pox . . .	0·16	0·25	0·05
Measles . . .	0·44	0·38	0·44
Scarlet Fever . .	0·97	0·72	0·34
Typhus . . .	?	0·06	0·02
Enteric Fever . .	?	0·33	0·20
Whooping-cough .	0·53	0·51	0·45
Diphtheria . . .	0·18	0·12	0·16
Diarrhœa . . .	0·97	0·92	0·66
Cancer . . .	0·39	0·47	0·59
Phthisis . . .	2·49	2·13	1·74
Heart Diseases, &c. .	1·05	1·34	1·58
Respiratory Diseases .	3·36	3·74	3·59
Urinary Diseases .	0·27	0·35	0·43
Violence . . .	0·77	0·74	0·65
ALL CAUSES . .	22·5	21·4	19·1

short intervals, makes it difficult to measure their average incidence against that of the more equable causes of death, or to compare the course of the death-rate of one zymotic disease with that of another upon anything like equal terms (*see* Periodicity in Disease). It is a disputed point whether the ominous increase in the mortality attributed to cancer is real, or only due to the better diagnosis of cases which in former years would have been assigned to other causes.

Density of Population.—Even apart from any correction for age and sex distribution, the death-rate is generally higher in urban than in rural districts. In both it is declining, but as the fall is more rapid in the former the difference is growing less.

England and Wales.—Urban and Rural Death-Rates, 1861–90.

Years	Persons per Square Mile	Death-rate per 1,000 living		
		England and Wales	Town Districts	Country Districts
1861–70	365	22·5	24·8	19·7
1871–80	415	21·4	23·1	19·0
1881–90	471	19·1	20·3	17·3

The average density in 1891 was 500 persons per mile, or 0·8 per acre. If below this average, the density seems to have little influence upon the death-rate; but if above it, the increasing density is in general associated with increasing death-rate. But the density per acre or per square mile is a very crude measure of the overcrowding which is hygienically most important. In a sparsely populated district there may still be overcrowding of villages, of alleys, of houses, or of single rooms. Sheffield is said to have rather less than 17 persons per acre, but this bare average goes for little, since in one registration sub-district the density is 249 per acre, and in another 0·5 only. In London the death-rate among the better class of many-storeyed 'model dwellings' was found to be lower than the average, notwithstanding a more than tenfold greater density per acre. Farr held that, *other things being equal*, the death-rate varies as the twelfth root of the density of the population; the very necessary proviso makes the formula difficult of practical application in a given case.

With the exception of diphtheria, all the zymotic diseases cause, on the whole, higher mortality in urban than in rural districts; and even diphtheria seems likely to conform to the rule in the near future, as it is gaining ground in many towns. Observations of a narrower kind, having regard to crowding of tenements, indicate that phthisis, respiratory diseases, and infant mortality are also conspicuously increased.

Mortality as affected by Occupation.—Here we have to do with a selected population—selected sometimes (*e.g.* miners) on account of robust health, sometimes (costermongers, for example) by unfitness for other pursuits. In all cases the age and sex distribution differ widely from that of a general population, and comparison has to be made after correction for this. Such a comparison upon equal terms has been made by Dr. Ogle (*Supp. to the 45th Ann. Rep. of the Reg.-Gen.*) with regard to a large number of trades. The following may serve as examples:—

Comparative Mortality according to Occupation.

—	Phthisis	Respiratory Diseases	Nervous Diseases	Urinary Diseases	Liver Diseases	Heart, &c., Diseases	'Comparative Mortality Figure'
All Males	220	182	119	41	39	120	1,000
Agriculture . .	122	156	80	22	20	97	701
Coal-mining (Lancashire) . . .	125	229	83	24	18	96	929
Wool Manufacture .	257	205	127	36	36	142	1,032
Cotton Manufacture .	272	271	142	32	43	112	1,088
Earthenware Manufacture . . .	473	645	140	49	49	160	1,742
File-makers (Sheffield)	433	350	262	123	41	180	1,667
Plumbers . . .	246	185	167	100	48	140	1,202
Innkeepers . .	140	217	200	83	240	140	1,521
Costermongers . .	475	420	207	69	47	227	1,879
Cornish Miners . .	690	458	117	38	40	111	1,839

The comparative mortality figure is lowest (556) among the clergy, and much higher (1,122) among medical men. It is highest of all among inn-servants (2,205).

Sickness.—Statistics of sickness are very incomplete. Those arising out of the compulsory notification of certain infectious diseases are not available except in detached local reports, nor are they tabulated upon any uniform plan even in districts where notification is in force. They apply to a limited number of diseases, and some of the most important are not included. Their chief statistical value at present is the measure which they afford of the local and periodic fluctuations in diffusion and case-mortality of each disease separately. Statistics of hospitals, asylums, and poor-law practice are useful, though fragmentary; and the records of the public services and of 'friendly societies' have yielded valuable results. All these have reference to 'selected populations,' and are not strictly relevant to average communities. For example, it is unsafe to draw conclusions as to the comparative age-incidence of enteric fever from hospital data, for there is no assurance that the cases in hospital are a fair sample of those outside in severity or in age-distribution.

It has been estimated that in a given community there will be about two weeks of sickness per head per annum, or about two to three years of continuous illness for each death. The incidence of sickness, unlike that of births or deaths, has to be considered with regard to *degree* and *duration*, so that the data, such as they are, scarcely lend themselves to statement in the ordinary form of rates.

Statistical Tests of Sanitary Condition.—It has become customary to regard certain statistical data as proof of the healthiness or unhealthiness of a locality, in the sense of prevalent impurity of air, water, soil, or dwellings. Chief among these in popular appreciation are the general death-rate, and the zymotic death-rate. The former is, upon the whole, a fairly reliable index of sanitary condition, but is liable to fallacy if the figures be small, or if the population be not accurately known, or if the age and sex distribution be abnormal, or, lastly, if care be not taken to exclude deaths of strangers, and to include deaths of residents dying outside the district. Further, purely local death-rates for limited periods of time are liable to disturbance by epidemics of a kind not dependent upon insanitary conditions.

The zymotic death-rate is of little constant significance in this respect. It is made up of the combined death-rates of the 'seven principal zymotic diseases,' of which four (small-pox, measles, whooping-cough, and scarlet fever) have little claim to rank as filth-diseases, although the others (enteric fever, typhus, diphtheria, and diarrhœa) have a much more direct significance.

An excessive infant mortality may be due to diarrhœa and other diseases attributable to filth conditions, but may also be accounted for by maternal neglect, or by epidemics of measles or whooping-cough. With equal reason the death-rates from phthisis and from respiratory diseases deserve to be taken into account.

The *mean age at death*, obtained by adding together the ages of those who die, and dividing by the number of deaths, is often cited as evidence of longevity, but has very little significance. It depends largely upon the age-distribution of the population; if there are many young children it will be low. By far the best criterion of longevity is, of course, the expectation of life, which can only be accurately ascertained from a life-table. Approximately it may be found by Farr's formula $x = \frac{2,000}{3D} + \frac{1,000}{3B}$, x being the expectation of life, B the birth-rate, and D the death-rate.

B. A. Whitelegge.

VITILIGO.—*See* Pigmentary Diseases of the Skin: 7. Leucoderma.

VITILIGOIDEA (*vitulus*, a spotted calf).—A term which was applied by Addison and Gull to the disease now known as *xanthoma* and *xanthelasma*. See Xanthoma.

VITTEL, in the Vosges, France.—Earthy mineral waters. *See* Mineral Waters.

VOCAL FREMITUS.—The sensation of vibration conveyed to the hand when applied over any part of the respiratory organs during vocalisation. It is felt in health, but presents various modifications in disease. *See* Physical Examination.

VOCAL RESONANCE.—The sound heard on auscultation over certain parts of the respiratory organs, during vocalisation, both in health and in certain forms of disease. *See* Physical Examination.

VOICE, Disorders of.—Synon.: Fr. *Troubles de la Voix*; Ger. *Störungen der Stimme.*

Introduction.—Voice is the sound produced in the larynx by air driven from the lungs through the rima glottidis, modified in accordance with acoustic laws in the upper air-passages. Vocalisation is a function needing for its perfect production a healthy condition of the respiratory muscles, of the lungs, trachea, and larynx, of the pharyngeal, oral, and nasal cavities, and of the nerves and nervous centres on which these parts depend for their isolated or coördinated muscular movements and their normal sensitiveness. For the production of the simplest vocal tone the cords must be free to approximate within a line of one another, while the coördinated action of about one hundred muscles is required, to regulate their tension and that of the walls of the air-passages, to modify the form of the latter, and to produce the current of air.

Acoustically the organ of the voice must be regarded as a combined reed and pipe; and for the production of a perfect note, it is necessary that the pipe should be in perfect unison with the reed. This unison depends not only on the shape of the various cavities, but on the relative rigidity or flexibility, and the tension of their walls; every variation in the number, size, or form of vibrations of the vocal cords, effected by the intrinsic laryngeal muscles, calling for similar modifications of the shape, size, and tension of the consonating cavities.

The word 'voice,' when used alone, always implies the presence of a musical tone (periodic vibrations), but sound sufficient for every purpose of speech and articulation may be produced without a musical tone. This is the *whispering voice*, caused by the rustling of air through the half-open rima and relaxed air-passages. To this condition —absence of musical tone in the voice—the term *aphonia* is applied, and it must be distinguished from the actual inability to produce sound, which we see after tracheotomy, where, in the effort to speak, the organs of articulation and sound are seen to move, but neither noise nor musical sound is heard.

PATHOLOGICAL RELATIONS.—The morbid modifications of vocalisation are necessarily numerous, in proportion to its complexity and the number of parts concerned in its production; but it may be generally stated that, in consequence of disease or perverted action in any of these parts, the voice may be altered either (1) in *loudness* or *force* (size of sound-waves); (2) in *pitch*, or relative height of its note (rate of sound-waves); or (3) in *quality* (shape of sound-waves). And even before there is obvious change in any of these respects, the power of passing rapidly and easily from one pitch to another, constituting melody, may be seriously impaired. The morbid alterations of the voice in these several directions will now be discussed; and brief reference will also be made to (4) *stammering of the vocal cords*; (5) *aphonia*; and (6) the *vocal signs in the chest.*

1. **Changes in Force.**—The voice is weakened in every disease which lowers the general muscular tone, or depresses the nervous system. The gradual change is well seen in phthisis without laryngeal affection, where at last even the effort to approximate the vocal cords is too much for the patient, and he speaks in only a whispering voice. In the same way painful affections of any of the parts enumerated above, interfering with muscular effort, weaken the voice. Speaking generally, mere diminished loudness of the voice depends usually on general rather than on laryngeal disease.

2. **Alterations in Pitch.**—The note of ordinary speech may be habitually raised or lowered, and the range of the singing voice may be seriously limited. The note of the voice depends primarily on the rate of vibration of the vocal cords; and this is the mean result of the tension, the length, the density, and the thickness of the cords at the time the tone is produced, and the force of the current of air sent through the rima. Structural changes, therefore, in any one of these respects, will alter the pitch of the voice; and change in the ordinary vocal note is usually to be referred either to an affection of the tensor muscles of the larynx, or to structural change in the mucous membrane covering the cords or in the cords themselves. Lowering of the pitch of the speaking and the range of the singing voice occurs with any condition which relaxes the mucous membrane, weakens the nervous and muscular systems, or makes the tense condition of the vocal cords and the consonating cavities painful. Paralysis of the intrinsic muscles, which admits of the approach of the vocal cords but interferes with their tension and density, affects the pitch as well as the quality, the voice being rough and deep in the paresis of the external tensors (superior laryngeal nerve) and of the abductors of the larynx (recurrent nerve).

The imperceptible transition from the chest to the falsetto voice, in which, whilst the condition of the vocal cords is suddenly altered, the form of the larynx, trachea, and other consonating cavities is simultaneously changed, requires a perfect control of the vocal organs, attained only by accomplished vocalists. On this change of register occurring involuntarily, the cracked voice in speaking is the result; and being referable to imperfect coördination, it is common in males about puberty, when the form of the larynx is changing, or may even persist occasionally throughout life. A curious affection of the pitch of the voice, in speaking, when two tones of different pitch are simultaneously produced (diplophonia), appears to depend on the division of the rima into an anterior and posterior opening, either by small morbid growths, strings of mucus, or irregular action of the muscles.

3. **Change of Quality.**—The quality of the voice is affected by every alteration, either in the cords or in the consonating cavities, the purity and character of the tone being liable to numerous modifications, until, the musical note disappearing entirely, mere noise (aphonia or whispering) remains.

Hoarseness.—Hoarseness and huskiness, a combination of whispering and a badly sustained musical note, imply imperfect and irregular approximation of the vocal cords. Over-exertion of the voice, catarrh, &c., produce it temporarily, giving rise to irregular tension of the cords, to shreds of mucus, and to swellings of the mucous lining, which interfere with their regular approximation; while all changes short of those which absolutely prevent the closure of the cords, may cause it as a persistent phenomenon. To the larynx itself we look, therefore, for the source of persistent hoarseness. Amongst the pathological conditions of which hoarseness is a symptom are chronic swelling of the mucous membrane, general or local, interfering with the closure of the rima; exudation or ulceration, and therefore inflammation, simple, specific, or diphtheritic; neoplasms; old cicatricial contractions; paralysis of the adductors of one cord, which necessitates the crossing of the normal cord beyond the median line to meet its fellow, as well as other forms of paralysis; and fixing of one vocal cord by ankylosis of the crico-arytænoid joint. The paralysis may, of course, depend on disease of the nervous centres, on the nerves themselves, or on pressure by intrathoracic or other tumours on the nerve-trunks. Hoarseness, short of aphonia, is also a symptom of general exhaustion, as seen in phthisis and cholera.

The character of the speaking voice is also altered by any change in the resonating cavities. Thus the voice is said to have a *nasal twang* when the upper pharyngeal and nasal cavities are not completely shut off in vocalisation; while, on the other hand, obstruction in the nares, preventing the passage of the air through them and the formation of the nasal consonant sounds, is popularly, though wrongly, called 'speaking through the nose.' If the obstruction be situated in front of the nares, the sounds can be produced, but not continued; if the obstruction be in the upper pharynx, or at the back of the nares, they cannot be produced at all. When with obstruction in the nares there is swelling of the pharynx and the soft palate, the voice assumes the character so familiar in cases of quinsy.

Changes in the walls of the chest and the pectoral cavities also alter the character of the voice, the hollow voice of the emaciated phthisical patient illustrating this. The phonation, on inspiration, of spasmodic croup and of child-crowing or laryngismus stridulus must be referred to as the result of spasm of the vocal cords, though this involuntary function hardly comes within the definition of 'voice,' which term should be limited to sound produced in the vocal organs to establish communication between living beings.

4. **Stammering of the Vocal Cords.** Spasm and defective coördination are the source of this peculiar affection of the voice, in which there are sudden interruptions of the voice without affection of the articulation (Prosser James).

5. **Aphonia.**—The various modifications of voice hitherto considered only occur where the vocal cords are free to meet more or less perfectly. Aphonia, or complete loss of the musical tone, occurs where the cords cannot meet. Amongst the conditions which will prevent the approximation of the cords and cause aphonia are paralysis or paresis of the adductor muscles, on whatever cause it may depend; fixation of the cords by cicatricial contractions, or by ankylosis of the crico-arytænoid joints; their destruction by ulceration; any painful affection which makes the patient involuntarily rest them; or coating with false membrane. But by far the most frequent cause of this aphonia is the abrogation or perversion of the will, occurring in the morbid mental condition of hysteria or other nervous disease; perfect power of phonation existing, but the patient, for months or years, declining to exercise the power, or to make the necessary effort. The intimate relations of the voice to the higher functions of the brain would lead us to expect that it would be influenced by the emotions. Thus we have a person hoarse with rage, speechless with terror, &c.; and the origin of these cases of nervous aphonia is frequently some sudden emotion, causing loss of control over the voice. Ziemssen believes that, even where the vocal cords cannot meet, by a great effort the patient may produce a hoarse, monotonous tone by vicarious vibrations of the ventricular bands.

TREATMENT.—The local treatment of the various diseases of the respiratory organs which give rise to disorders of the voice, is fully discussed in the several articles on these subjects (*see* LARYNX, Diseases of; STAMMERING; PHARYNX, Diseases of; TRACHEA, Diseases of). The *general* treatment will depend upon the constitutional state. *See* HYSTERIA; and PHTHISIS.

6. **Vocal Signs in Chest.**—Some consideration must be given to the changes in the voice which are audible when the stethoscope is applied to the chest. Normally the vibrations of the vocal cords are conveyed to the ear applied to the chest by propagation along the contained air, the rigid portions of the air-chambers, and the thoracic walls, the voice being heard as a feeble, buzzing, musical tone. This sound is weakened when the original tone is weakened by laryngeal disease; when fluid is interposed between the lung and the chest-wall; and when the bronchial tubes are obstructed by secretions or other cause, preventing the conveyance of the vibrations. The sound may, on the contrary, be exaggerated, giving rise to the phenomena of *bronchophony*, *amphoric voice*, and *ægophony*. Bronchophony is simple increase in the vocal resonance, and is heard under the same conditions which give rise to bronchial breathing, that is, over lung consolidated by exudation or condensed by compression, and over cavities with solid walls. The term *pectoriloquy* is commonly applied to excessive bronchophony, but Dr. Bristowe would limit it to those instances in which not only the laryngeal tone, but the articulate sounds produced in the mouth, are conveyed back to the chest, and thence through the chest-wall to the ear. Amphoric voice (*amphorophony*) is the term applied where the vocal resonance is not only increased, but acquires a metallic ring, from the addition of a consonant tone acquired in large cavities of the lungs. This is sometimes heard in a marked degree in pneumothorax, though in other cases of the same disease the vocal resonance may be absent or greatly diminished.

Ægophony is heard where there is a thin layer of fluid between the ear and the lung, as in small effusions or at the margin of larger effusions. It is a bleating, tremulous tone, supposed by Stone to result from the interposed fluid preventing the fundamental note-vibrations from reaching the ear, while it permits the finer and closer vibrations of harmonics to penetrate. *See* PHYSICAL EXAMINATION.

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VOLITION, Disorders of.—Synon.: Fr. *Troubles de la Volition*; Ger. *Störungen des Wollens.*

Various lesions of the cortex of the hemispheres may arrest or interfere with volition at its source, and that not solely when the lesions occur in the kinæsthetic or so-called 'motor' regions. If we assume that these particular regions of the cortex are the parts whence motor incitations pass off on their way to lower centres, it is only necessary to bear in mind, on the one hand, the continuity of molecular actions through definite tracts of the brain-tissue, and, on the other hand, the frequency with which volitions are immediately aroused by some antecedent sensorial processes, to understand that damages to certain sensorial centres or commissural fibres within the hemispheres are almost as liable to interfere with certain classes of volition as are those which occur in the kinæsthetic region itself. After all, volition is only, and must always be, a result of sense and intellect in action. Its manifestations may, therefore, be *impeded* either by disease at the sources in which it originates, or in one or other portion of the tracts along which its initial incitations are conducted on their way to motor centres, and thence to the muscles whose activity is to be awakened. (*See* 'On the Neural Processes underlying Attention and Volition,' *Brain*, April 1892.)

In other cases, with *exalted* activity of some of the centres in which volitional incitations arise, we may have, especially in acute mania and violent delirium, the birth of impulses which are absolutely 'uncontrollable.' Where these conditions are absent, however, and whether the persons in question have been accustomed or not to exhibit evidences of a weak or defective *morale*, it is most important not to confound 'uncontrolled' with 'uncontrollable' impulses. This is the kind of question which becomes all-important in many criminal cases—cases, that is, in which persons are under trial for murder, manslaughter, or theft, and in which 'unsoundness of mind' is pleaded in extenuation. *See* Criminal Irresponsibility.

On the other hand, a *dormant* or *sluggish* volition is met with in some other forms of insanity, as well as in hysteria, the subjects of which cannot or do not rouse themselves to perform the most ordinary actions. They may from this cause be speechless, or they may experience the most extreme difficulty in arriving at any decision even in reference to the most trivial circumstances—a defect which is very commonly met with in patients suffering from melancholia. *See* Insanity, Varieties of.

Again, so-called defects of memory and *defects* of volition are sometimes inextricably involved in many forms of brain-disease; so that the same disability may, from one point of view, be regarded as an instance of defective memory of a special kind, or from another as a peculiar and limited interference with volition. *See* Memory, Disorders of.

In very many cases of apparent *loss* of volitional power—that is, in multitudes of instances of complete paralysis of a part or of a muscle—where the causal lesion is situated in regions below the cortex cerebri (*e.g.* in lower motor centres, bulbar or spinal, or in motor nerves), there is not an arrest of volition, but rather an impediment to the actuation of volitions (*see* Paralysis, Motor). But whether volition itself is nipped in the bud, or whether, though really existent, it is rendered abortive, the patient is practically reduced to the same condition—since his power of responding to sense or thought through particular muscles may be equally interfered with in either case. *See* Speech, Disorders of.

H. Charlton Bastian.

VOLVULUS (*volvo*, I roll).—A form of intestinal obstruction in which the bowel is bent or twisted on itself. *See* Intestinal Obstruction.

VOMICA (*vomo*, I vomit, I cast up).—Synon.: Fr. *Vomique*; Ger. *Lungengeschwür.*

Definition.—A term applicable to all ulcerative spaces in the lung in open communication with bronchi.

Ætiology.—The multifarious agencies leading to excavation may be grouped as follows:—

I. *Destructive processes*: (*a*) injury, (*b*) gangrene.

II. *Suppurative processes*: (*c*) acute pulmonary abscess; (*d*) suppuration around inhaled foreign bodies; (*e*) suppuration around new-formations (including hydatids); (*f*) extension of abscesses—(1) from the pleural cavity; (2) from the abdominal cavity, or from the abdominal organs; and (3) from the mediastina.

III. *Degenerative processes*: (*g*) ulceration of cancerous or sarcomatous growths; (*h*) ulceration of syphilomata; (*i*) ulceration of tubercle; (*j*) softening of chronic inflammatory consolidations (catarrhal pneumonia and caseous pneumonia); (*k*) softening of intensely congested or œdematous tissues (a condition sometimes due to pressure from aneurysms or tumours); (*l*) liquefaction of ancient deposits—caseous, pultaceous, or hæmorrhagic (hæmorrhagic nodules—Dr. R. E. Thompson).

Phthisis being the cause of the immense majority of pulmonary excavations, the ensuing remarks will be chiefly devoted to phthisical vomicæ.

Anatomical Characters.—*Varieties in size and in shape.*—Vomicæ may be sublobular (then aptly termed *cavernules*), lobular, lobar, or they may involve the whole of one lung. Tubercular deposits, being usually smaller than catarrhal infiltrations, lead to smaller cavities. Catarrhal inflammation gives rise to the lobular, caseous pneumonia to the lobar excavations, and to the wholesale destruction of a lung. Œdematous forms of catarrhal pneumonia often undergo rapid and extensive softening; the interlobular septa escaping liquefaction, whilst the parenchyma is carried away. This dissecting excavation forms the counterpart of caseous pneumonia, where the tissues are destroyed *en masse*, with the sole exception of the larger branches of the pulmonary artery.

When strictly confined to a lobule, the excavation is roughly spherical. If many lobules should be simultaneously involved, their coalescence may give rise to irregular vomicæ; but the ultimate shape of cavities chiefly depends upon the peculiarities of the bronchial distribution to the district affected.

Vomicæ are frequently trabeculated. Trabeculæ (clearly to be distinguished from denuded branches of the pulmonary artery) invariably consist of blood-vessels and of collapsed or indurated alveolar substance. They are the remains of intervals of spongy tissue, originally separating distinct cavities. Their ulceration and partial absorption often give rise to a knobbed condition of the internal surface of cavities.

During the period of formation and of extension the walls of cavities are rough and ulcerous. But the completed cavity becomes surrounded by a fibro-vascular zone, the outer surface of which is continuous with the pulmonary tissue, whilst its innermost stratum constitutes, during the active stages, a pyogenic layer, and subsequently an exfoliating false membrane. Vomicæ thus invested are said to be *encapsulated*.

Important differences are noticeable in the condition of tissues around cavities. The capsule of a vomica may be immediately surrounded by alveolar substance, the expansion of which may exert a favourable amount of pressure upon it; or it may be continuous with inflamed and thickened tissue, or with tubercular infiltrations. In extreme cases the lung is to such an extent invaded by the fibrous growth from an adherent pleura, that the vomicæ present the appearance of having been formed at the expense of the fibrous tissue itself ('fibroid phthisis').

Situations. — No appreciable difference exists between the liability to excavation of the right and that of the left lung. Primary excavation almost invariably attacks the upper part of the upper lobe; its most common seat is the central part of the subclavicular region, not the apex proper; it may, however, extend to the very summit of the lung, or involve the greater part of the upper lobe. Phthisical destruction very rarely has its starting-point in the middle or in the lower third of the lung. The base of the lung, on the other hand, is the most common seat of those cavities which are not due to phthisis (for example, abscesses by extension, gangrene, and syphilitic ulceration).

The common form of phthisis, originally attacking the apex, implicates, almost without exception, the mid-dorsal region secondarily; this the writer has shown to be due to the transmission of irritating matter along the bronchus supplying that district. Similarly the base becomes affected in the latest stages of excavating disease, if life should be sufficiently prolonged.

Bronchi in relation to vomicæ.—Cavities not smaller than a lobule inevitably open into a bronchus. The communication may be temporarily obliterated, or it may in rare instances become permanently sealed. Most cavities exceeding the size of a single lobule intercept more than one bronchus; and the air-tubes ulcerate within them at an early period of the softening. Thus two sets of bronchial orifices may be recognised in vomicæ, the proximal and the distal, forming as many small islands of mucous membrane on the internal surface of cavities.

Blood-vessels in relation to vomicæ. — Trabeculæ always contain either patent or obliterated vascular branches. More resistant than all other structures, these vessels may become completely exposed and finally eroded. But aneurysm or erosion more commonly has its seat in those branches of the pulmonary artery which ramify in the thickness of the cavity wall, a fact readily explained by the persistence of circulation within these vessels, by their inability to retract, by the uneven support which their coats receive at different points of their circumference, and by their diseased condition. Fatal hæmorrhage may occur, without any warning, from the erosions or from the aneurysms. More habitually premonitory bleeding of limited extent recurs at short intervals prior to the fatal rupture. Pulmonary aneurysms sometimes undergo spontaneous cure when their growth is limited by the small size of the cavity which contains them; or the pressure of the extravasated blood may effect the same result subsequently to their rupture. It is almost the rule for aneurysms to occur simultaneously at different parts of the same lung.

Extension of vomicæ.—Cavities increase in size by the gradual necrosis of their inner wall; by the fusion of adjacent excavations; and by their encroachment upon fresh bronchial territories, which become the seat of similar ulceration.

Retrocession of vomicæ.—The *contraction* of cavities is essentially due to the shrinking of their capsule. This force is assisted in some cases by the expansion of the neighbouring spongy tissue, or even of the hypertrophied healthy lung; in other cases by the constricting pressure from a thick zone of fibrous tissue; indirectly also by the falling-in of the ribs, by the rise of the diaphragm, and by the abundant growth of new fibrous tissue in the thickness of the pleural adhesions.

The *retraction* towards the root of the lung, which is so commonly observed in chronic vomicæ, is partly due to the inflammatory thickening and shortening of the bronchus; it is often opposed by adhesions of the corresponding pulmonary surface to the chest-wall.

In their contracted state vomicæ may remain dormant for years. Final obliteration is rarely attained, chiefly owing to their deficient granulating power, and to the superficial necrosis of their opposed surfaces, both these conditions being the outcome of imperfect drainage.

CONSEQUENCES OF EXCAVATION.—Amongst the *general* consequences of pulmonary excavation are loss of breathing-surface; exhausting suppuration, often leading to lardaceous degeneration of the organs; and tuberculosis. The chief *local* consequences are secondary deposits (pneumonic or tubercular) in the healthy portions of the lungs, as a result of the inhalation of the secretion of cavities, and of other products. Lastly, as the result of the contraction of cavities, we meet with local shrinking of the lung and collateral emphysema; various involutions of the pulmonary surface; various deformities of the thorax, &c.

Among the fatal accidents incidental to excavation rupture of aneurysms has already been referred to. Perforation of the lung, leading to pneumothorax, is a danger special to the more insidious varieties, in which the softening is rapid, whilst the inflammation is of low type and unaccompanied with the usual tissue-reaction on the part of the lung and pleura.

DIAGNOSIS.—The ordinary methods of physical examination, by which the presence of cavities may be detected, are described in other articles (*see* PHTHISIS; and PHYSICAL EXAMINATION). A few points only claim specially to be noticed. Cavernous sounds are seldom given by cavities smaller than an ordinary filbert, probably owing to the small size of their bronchus. Cavities even of larger size are not infrequently completely masked by the interposition of spongy tissue; this is more especially the case in the tubercular forms. In the opposite condition of cirrhosis, cavernous sounds may be absent or very feeble, in consequence of deficient inspiratory movements. Lastly, the accidental blocking of a bronchus may suspend for a time all auscultatory evidence of excavation. The distance of the vomica from the surface may be roughly estimated from the intensity of the sounds; its degree of fulness from their liquid character; the smoothness of its walls from their amphoric nature; its compressibility by surrounding spongy substance, and its elastic resiliency, from the suction-sound sometimes heard during the respiratory pause following cough, aptly termed by Dr. Mitchell Bruce the *indiarubber-ball sound.*

A determination of the extent of the vomica can generally be attained by careful investigation. Sometimes, however, cavernous sounds are propagated beyond the excavated region by consolidation. Occasionally they are re-echoed at a symmetrical point in the sound lung, especially at the base. Phantom-caverns of this nature may be suspected whenever absolute identity in the position and in the auscultatory quality of the sounds on either side coincides with great disparity in percussion-resonance and in vocal fremitus.

Valuable information is derivable from the *sputa.* Abundant purulent discharge always indicates an active condition; if mixed with much mucus, it points to a coexisting bronchial catarrh; if shreddy and fœtid, to a cavity of some magnitude, imperfectly drained. The intimate admixture of blood indicates a congested state of the membrane. From the presence of abundant, well-preserved, elastic elements it is possible to diagnose the moister forms of necrosis; caseous lumps argue the existence of caseous pneumonia; the expectoration of calcareous particles shows that excavation is progressing at the expense of more or less fibrosed tissue resulting from former disease; and the discovery of bacilli of tubercle removes all doubt as to the specific nature of the affection. Lastly, the cessation of all secretion is indicative of a perfect quiescence of the vomica.

PROGNOSIS.—In cavities not due to phthisis, the absence of the constitutional element greatly favours recovery; and their progress is mainly governed by the nature of their cause, by their size, by their situation, and by other influences enumerated below. Where healing is much delayed in such cases, the eventual development of phthisis is rendered probable.

The prognosis of phthisical vomicæ is intimately bound up with the prognosis of phthisis, a subject too wide for discussion here, but fully treated in the article PHTHISIS, and in Dr. James Pollock's work on *The Elements of Prognosis in Consumption.* Most unfavourable are the vomicæ due to a breaking up of tuberculo-pneumonic deposits. Vomicæ originating in pure tubercle, although they may contract, seldom heal. Where hæmorrhage occurring in a lung apparently quite free from disease subsequently leads to excavation, the closure of the cavity is encouraged by the contraction which characterises these cases. But the pneumonic class, which comprises the most rapidly fatal cases of excavation, also supplies the most striking instances of recovery. There exists a large clinical group in which the affection is limited to a small portion of one lung, and in which the disease is rather local than constitutional. On careful analysis of these favourable cases, the chief elements of their fortunate termination will be found to be the following: (1) unilateral character of the affection; (2) its small extent; (3) comparatively rapid occurrence of softening; (4) complete removal of the whole consolidation; (5) absence of close adhesions to the thoracic parietes; and (6) facilities afforded for collateral expansion.

TREATMENT.—The ideal treatment of cavities would have for its objects: (1) to restore healthy action to their surface; (2) to prevent a stagnation of their secretions; and (3) to encourage their contraction.

For the fulfilment of these indications various *surgical* measures have been practised: (1) free incision and injections (Barry, 1727); (2) paracentesis (Ramadge, 1836); (3) free incision and drainage (Hastings and Storks, 1845); (4) paracentesis and injections (Mosler, 1873); (5) needle-injections of medicated fluids (Pepper, 1874); (6) the resection of ribs over the site of a vomica, proposed by Neve (1887), and carried out by Quincke (1888).

Much was once expected of modern surgery in the treatment of excavating disease of the lung. Hitherto, however, there exists but meagre evidence to show that any good has resulted from surgical interference, and the range within which such interference is justifiable is very limited.

The *ordinary* methods of treatment comprise, in addition to the use of constitutional remedies:—

(1) Treatment by *inhalation* of medicated spray, of medicated vapours, of air charged with the natural exhalations from the sea, from pine-forests, &c. *See* INHALATION; and CLIMATE, Treatment of Disease by.

(2) Treatment by *posture*, sometimes facilitating the drainage of cavities.

(3) Treatment directed to the enlargement of the thorax and to the *expansion* of the lungs, such as exercise of the thoracic muscles, inhalation of rarefied air, and especially residence at high altitudes.

WM. EWART.

VOMIT: Examination of Vomited Matters.—Vomited matters may consist either of substances present in the stomach when vomiting begins, or of substances entering it during the process. Those present in the stomach *when vomiting begins* include articles of food and drink, drugs, poisons, or other ingesta, more or less altered by digestion or fermentation; saliva, epithelium, mucus, pus, or blood from the nasal passages, mouth, pharynx, or œsophagus; fluid or mucus secreted by the stomach itself, epithelium-cells, casts of tubules, or even shreds of gastric mucous membrane, blood more or less altered proceeding from the walls of the stomach, cells, or small pieces from morbid growths, and occasionally, as mentioned by Sir Richard Quain, the whole of a pedunculated morbid growth; fungi, as torulæ and sarcinæ; parasitic worms; bile; pancreatic juice; pus from abscess of the stomach or liver; or fæculent matter from the intestine. *During vomiting* much saliva may be swallowed; and bile, pancreatic juice, pus or fæces, not originally present in the stomach, may be pressed into it by the straining. Effusion of blood into its cavity may also be caused by the efforts of retching.

Method of Examination.—In examining the vomited matters it is advisable, first, to separate the larger pieces of undigested food by filtering the vomit through canvas or muslin.

The *solid residue* may be investigated by washing the larger pieces and tearing them up, or making sections of them, so that their nature may be ascertained. Partially digested curd is sometimes not very easy to recognise. If a large quantity of milk have been drunk at one time, the curd which it forms in the stomach may, when vomited, have the appearance of a piece of thick, dense, grey felt.

The *filtrate* should be put into a conical glass and allowed to settle. The reaction of the fluid is to be ascertained by litmus paper. The presence of free hydrochloric acid may be tested for, by putting one drop into a watch-glass containing a 1 per cent. solution of tropeolin, the yellow colour of which is converted into a wine-red if hydrochloric acid be present. Another test is a solution of phloroglucin two parts, vanillin one part, and absolute alcohol thirty parts. A few drops of this are placed with an equal bulk of the filtrate in a porcelain dish and gently heated. If hydrochloric acid be present a deep or bright red colour is produced; if it is absent the colour is brownish-red or brown. The total acidity may be estimated by filtering, and adding a standard solution of caustic soda or potash to a measured quantity of the filtrate, until it is neutralised. For the methods of examining more particularly the various acids—lactic, acetic, butyric, &c.—and other volatile substances, *see* STOMACH, Diseases of: 4. Cancer.

To ascertain the presence of pepsin in the vomit we add to it its own bulk of dilute hydrochloric acid (ten minims of diluted hydrochloric acid, B.P., to an ounce of water) and a flock of fibrin or a piece of hard-boiled white of egg; let it stand for several hours in a warm place; and then see whether or not the fibrin or albumen is dissolved.

To test for trypsin, we proceed in the same manner, but use the vomit without the addition of acid; and if it be already acid, neutralise it with bicarbonate of sodium.

To test for rennet, we add some neutralised filtrate to some neutral milk, and let the mixture stand at 98° for half an hour. If rennet is present coagulation will occur.

To test the vomit for peptone, we must put some of it into a small dialyser, and let it stand for some hours. We then add to the water in which the dialyser has stood, solution of corrosive sublimate, which gives a precipitate with peptones; or some liquor potassæ and a drop of very dilute sulphate of copper solution, which gives a precipitate dissolving on shaking, and forming a red solution, changing to purple when more copper is added.

Bile is tested for in the filtered liquid by Gmelin's and Pettenkofer's tests.

For blood in the vomit, *see* HÆMATEMESIS.

If the vomited matter be too thick to allow the sediment to subside, a little of it should be mixed with some distilled water and allowed to settle. A drop of the sediment is then to be examined microscopically; and the examination is facilitated by adding to one specimen a drop of iodine solution, and to another a drop of aniline red or blue solution. The substances most likely to occur are partially digested fibres of voluntary or involuntary muscle, elastic fibres, connective-tissue bundles from meat in the food, spiral fibres and green chlorophyll-granules from vegetables, starch-granules (stained blue by iodine), torulæ or sarcinæ, blood-corpuscles, leucocytes, scaly epithelium from the mouth, cylindrical epithelium from the stomach, and casts of the gastric follicles—sometimes fibrinous, sometimes composed of cells and granules which take up the aniline colour and are thus rendered more easily visible.

Poisons in vomited matters must be searched for by special chemical methods.

Clinical and Pathological Indications.—If the vomited food be unchanged, or but little changed, it indicates either that the vomiting has occurred soon after a meal, or that the secretion of gastric juice is deficient either in quantity or in quality. The food is usually comparatively little changed in nervous vomiting, or in cancer of the cardiac extremity of the stomach. In vomiting from cancer of the pylorus, or duodenal ulceration, the food is much more digested, as it remains much longer in the stomach. If undigested food be vomited some hours after a meal, the vomit should be examined in order to ascertain whether pepsin or acid be deficient. Complete absence of hydrochloric acid has been observed in cases of cancer and amyloid degeneration of the stomach, and a deficiency of this acid has been found experimentally in acute anæmic and febrile conditions. Abnormal acidity from fermentation of saccharine or farinaceous articles of food, and the consequent production of acetic, lactic, and butyric acids, occurs in chronic catarrhal conditions. In some cases of gastric catarrh starch appears to undergo a mucous fermentation, and large quantities of glairy material are formed. When fermentation has gone on to a great extent, the vomit may have a yeasty look, and should then be examined for sarcinæ and torulæ. *See* SARCINA; TORULA; and STOMACH, Diseases of: 7. Dilatation.

Sometimes large quantities of a watery fluid are vomited. This is occasionally alkaline or neutral, contains potassium sulphocyanide, and digests starch. It consists of saliva, which has been secreted abundantly on account of reflex irritation arising from the stomach, and swallowed. At other times it is strongly acid, and appears to be secreted by the stomach. Sometimes the vomit appears to be a mixture of both of these fluids. Such vomiting may occur from nervous disturbance of the stomach, but may be symptomatic also of catarrh, ulcer, or cancer. Mucus in the vomit indicates catarrh of the gastric mucous membrane; and the more acute the inflammation, the more leucocytes occur in the mucus. Bile may be vomited pure, in the form of a tasteless golden-yellow substance like yolk of egg, from the action of poisons, but this rarely happens. Vomiting of bile, more or less green and diluted, or mixed with digestive secretions or food, occurs as a symptom in congestion of the liver; but it may take place in all kinds of vomiting, whatever its cause. Large quantities of bile, mixed with the secretions from the mouth and stomach, and forming a grass-green liquid (*vomitus æruginosus*), may be vomited in peritonitis and cerebral affections. The writer has also observed this character of vomit in opium-eaters. Constant absence of bile, when vomiting is persistent, points to pyloric stenosis. Pus may get into vomit from the bursting of an abscess in the mouth or tonsils; it sometimes, though rarely, may arise from an abscess in the walls of the stomach; but it is more likely to come from abscess of the liver. Blood vomited in large quantity, and of a bright red colour, usually indicates ulceration of the stomach or cirrhosis of the liver. More or less altered, and in smaller quantity, it occurs in the diseases just mentioned, and also in cancer and yellow fever (*see* BLACK VOMIT; and YELLOW FEVER). It may also be present in hysterical persons who have swallowed blood, obtained from external sources, or by sucking hollow teeth. Cancer-cells in the vomited matters are diagnostic of the presence of malignant disease.

T. LAUDER BRUNTON.

VOMITING (Lat. *vomo*).—Synon.: Fr. *Vomissement*; Ger. *Erbrechen.*

Definition.—Forcible expulsion of the contents of the stomach through the œsophagus.

Ætiology and Pathology.—Two things are necessary in vomiting, namely, squeezing of the stomach, and relaxation of its cardiac orifice. Although the muscular fibres of the stomach itself may contract under the action of emetics, they seem to be unable to expel its contents unless aided by external pressure, for when the muscles of the abdomen are cut across vomiting does not occur. When the diaphragm and abdominal muscles are paralysed, vomiting is impossible, though the stomach may be in active movement. The stomach is not necessary to vomiting, which will occur when that organ is excised, and a simple bladder tied in its place; but when the stomach is present, mere pressure upon it by the diaphragm and abdominal muscles, as in coughing, does not expel its contents. In vomiting, the contents of the stomach are squeezed out of it by the mechanical pressure of the diaphragm and abdominal parietes contracting simultaneously. When these muscles contract, if the cardiac orifice of the stomach remains closed, an ineffectual effort at vomiting, or retching, occurs; but if the cardiac orifice dilate, the gastric contents are expelled. The cardiac orifice is relaxed by means of the longitudinal fibres, which run along the under end of the œsophagus below the diaphragm, and then radiate completely over the stomach. When they contract they dilate the cardiac orifice, and at the same time aid the evacuation of the stomach by drawing the whole viscus towards the diaphragm. In the act of vomiting, then, the simultaneous contraction of three sets of muscles is required: (1) of the diaphragm, (2) of the abdominal wall, and (3) of the muscular fibres just mentioned in the stomach itself. The movements of these muscles are coördinated by a nervous centre, situated in the floor of the fourth ventricle in the medulla oblongata. This centre is closely associated with, though of course not identical with, the respiratory centre. The motor impulses from this centre are sent to the abdominal muscles, diaphragm, stomach, and œsophagus, by the intercostal, phrenic, and pneumogastric nerves respectively. The reasons for supposing that the nervous centre for vomiting is closely associated with the respiratory centre, are that the movements of vomiting are modified respiratory movements, that emetics excite the respiratory centre, and that their action is usually preceded by increased respiratory movement, while depression of the activity of the respiratory centre stops vomiting. When the blood is rendered very arterial by excessive respiration, a condition of apnœa, in which no need of respiration is felt, and no respiratory movements are made, is produced; but if emetics are then injected into the veins, respiration not only becomes more frequent, but apnœa can no longer be induced, unless the activity of the respiratory centre be lowered by narcotics.

The vomiting centre is usually excited to action by irritation of certain *afferent nerves.* These may act either directly upon it, or through the medium of the brain. The nerves of special sense act through the brain. The sight of a disgusting object, a disagreeable stench, or an unpleasant taste, may excite vomiting, and it may also be produced by the simple thought of such subjects. A blow on the head, or inflammation of the brain or its membranes, also excites vomiting. According to Budge, the cerebral centres for the movements of the stomach are in the right corpus striatum, and especially in the right optic thalamus. When these parts are irritated the stomach moves. Irritation of the corresponding parts on the left side of the brain does not affect the stomach. Vomiting occurs in certain cerebral conditions, either affecting the brain itself or its membranes, such as cancer or tubercle of the brain, apoplexy, cerebellar hæmorrhage, softening of the cerebral substance, sometimes encephalitis, poisoning by narcotics, melancholia, profuse hæmorrhage, or tubercular meningitis. It is also one of the symptoms of Menière's disease of the semicircular canals. It also occurs in various diseases, in which, however, it is difficult to say whether the vomiting be due to direct affection of the brain itself, or to reflex action upon it from other organs. Such diseases are typhus, plague, yellow fever, cholera, and the cold stage of ague. Very painful impressions on sensory nerves throughout the body may excite vomiting. This is seen in cases of loose cartilages in the knee, in dislocation of a joint, or in a painful wound or operation. Here, also, it is uncertain whether the vomiting be produced through a direct connexion of sensory nerves with the vomiting centre, or whether the irritation acts indirectly through the cerebrum.

Certain afferent nerves appear to have a more direct connexion with the vomiting centre than others, and these require special consideration:—

(1) *Branches of the glosso-pharyngeal nerve to the soft palate, the root of the tongue, and the pharynx.*—These parts have a very close connexion with the vomiting centre, and tickling them with the finger or with a feather is one of the readiest means of inducing vomiting.

We find vomiting occurring in inflammation of the soft palate or tonsils, and also of the pharynx, especially in children.

(2) *The nerves of the stomach.*—The sensory nerves of the stomach are chiefly

branches of the vagi, but they belong partly also to the sympathetic system. When the vagi are cut, vomiting becomes difficult, but efforts at retching occur, and the writer has seen vomiting take place from the action of emetics after section of the vagi. It is therefore evident that irritation of the stomach produces vomiting reflexly through other nerves than the vagi. Vomiting may occur from irritant substances in the stomach, whether introduced into the stomach, or formed within it; from irritation within the stomach, due to an inflamed or irritated condition of its walls; or from mechanical pressure, from without or from within. Thus it may occur from the presence of undigested food, from irritating substances produced by imperfect digestion, or from irritant poisons within the stomach. It may be due to catarrh or congestion of the mucous membrane itself, to softening of the mucous membrane, or to ulcer or cancer in the gastric wall. It may be produced by extreme distension of the stomach, by gas, liquids, or solids; by compression of a part of it within the body, as in hernia of the stomach; or by the pressure of a tumour upon it. It may be caused by violent compression externally with the hands; by the pressure of a too tightly laced corset; by the pressure against the abdominal walls of hard tools or benches in certain trades. It frequently occurs in cough, especially the cough of phthisis; but here it is probable that the vomiting is due partly to the violent compression between the diaphragm and abdominal walls, and partly to the congestion of the vessels which the continued interruption of the circulation during the fit of coughing brings on.

(3) *The nerves of the liver and gall-ducts.*—These consist chiefly of branches of the vagus and sympathetic. From irritation of them vomiting occurs in hepatitis, or during the passage of a biliary calculus. It is from irritation of these branches, also, that vomiting may occur in pleurisy of the right side, the congestion of the pleura on the upper surface of the diaphragm having led to congestive changes in the liver.

(4) *Intestinal nerves.*—Ligature of the intestine in animals produces vomiting, which is arrested by dividing the nerves passing from the ligatured parts. In man it is the almost invariable accompaniment of strangulated hernia or intussusception, and it may even occur in obstruction of the bowel by fæcal matters in cases of obstinate constipation. It also takes place in peritonitis from irritation of these nerves.

(5) *The renal nerves.*—Vomiting occurs from irritation of these nerves, as by calculi in the pelvis of the kidney or passing down the ureter, and also in nephritis.

(6) *Vesical nerves.*—In cystitis vomiting occurs. It may possibly be due, however, not to irritation of the vesical nerves, but to extension of inflammation to neighbouring parts.

(7) *Uterine nerves.*—Irritation of these nerves is one of the commonest causes of reflex vomiting. It may be produced in animals on irritation of the uterine plexus, and occurs in the human subject during pregnancy or in metritis.

(8) *Ovarian nerves.*—Vomiting is a symptom of inflammation of the ovaries.

(9) *The nerves of the testicle.*—A blow on this organ tends very readily to produce nausea and vomiting.

The cause of vomiting in *sea-sickness* is uncertain; but it appears to the writer to be partly due to the condition of the nerve-centres, and partly to that of the viscera. *See* SEA-SICKNESS.

TREATMENT.—The treatment of vomiting is to be directed to two ends—(1) *to remove the cause* if possible; and (2) to *lessen the irritability of the vomiting centre.* The chief drugs which lessen the irritability of the vomiting centre are opium, morphine, bromide of potassium, chloral hydrate, and probably, also, hydrocyanic acid and belladonna. Strychnine and small doses of ipecacuanha are also useful in vomiting, and they probably owe their power to their action on the vomiting centre. Most of these drugs have a local sedative action on the stomach, and therefore it is advantageous to give them by the mouth when possible. Even when the stomach is very irritable, they may be retained by giving them in a concentrated form. When the stomach will not retain them, they must be given by the rectum or by subcutaneous injection. In sea-sickness the effect of the position of the head is sometimes very marked, and the vomiting may occasionally be arrested completely by removing all pillows and putting the head on a level with, or rather lower than, the body.

In cases of disease of the brain or its membranes, where it is difficult or impossible to remove the cause, we must try to lessen the congestion by means of leeches and cold applications to the head; and also to soothe the vomiting centre by diluted hydrocyanic acid, or by bromide of potassium. At the same time, however, considerable benefit is obtained from the use of remedies which act locally on the stomach, these seeming to have some reflex effect upon the vomiting centre. One of the most useful is ice, which may be constantly sucked, and also swallowed in small lumps. Where the vomiting is dependent on the action of the poisons circulating in the blood, as in the later stages of contracting kidney, we must endeavour to eliminate these by increasing the action of the kidneys and of the skin. In vomiting dependent on inflammation of the mouth and fauces, we lessen the irritability by soothing or astringent gargles, confections, or glycerine. A confection or glycerine is often better than a gargle, inasmuch as it remains longer attached to the parts, and thus exercises a more prolonged effect upon them. When vomiting is due to irritant substances in the cavity of the stomach, such as indigestible food, and acrid fluids or poisons, it is best treated by evacuating them. A large draught of lukewarm water, alone or mixed with a teaspoonful of mustard, is one of the best means. Large draughts of warm water alone, even if they are not ejected, may give relief by diluting the acrid substances in the stomach so much as to prevent their irritating the mucous membrane. In this way they sometimes relieve sick-headaches. It is of great importance sometimes, not only to prevent the formation of acrid substances by slow and imperfect digestion, but to prevent the mechanical irritation of the mucous membrane by undigested food. For example, we not infrequently notice that sickness and vomiting will occur in susceptible individuals after meals containing such substances as are not only slowly digested, but are swallowed in lumps. Examples of these are uncooked apples and cheese, or even potatoes, especially when imperfectly boiled or new. These articles, instead of being crushed to a powder by the teeth, are swallowed in lumps of considerable size, and apparently, instead of passing the pylorus, are retained in the stomach, and, partly by the mechanical irritation, and partly by their giving rise to acrid products, cause sickness. Milk, when swallowed in large draughts, or when there is too much acidity in the stomach, instead of falling in fine flakes will coagulate in large lumps, which have a similar effect to cheese. To prevent this it is advisable to mix the milk with soda-water or lime-water, or to take it, as in the whey cure, by sipping.

When vomiting is due to slow or imperfect digestion, which allows decomposition or fermentation of food to take place in the stomach, it may be arrested by improving the digestion. Thus five grains of calomel, by acting on the stomach through the liver, may arrest vomiting; and tincture of walnut (the active principle of which, juglandin, is an hepatic stimulant) has also been recommended. Pepsin also, by facilitating digestion, may prevent vomiting; and bitters, such as calumba, may do so by preventing putrefaction or fermentation.

When decomposition or fermentation of food, with formation of acrid or irritating products, has once set in, it may continue a long time, as the organisms which cause it remain constantly in the stomach, and renew the process in every fresh supply of food. It may be stopped by antiseptics. Where the vomited matters are frothy and yeasty-looking, the sulphurous acid of the Pharmacopœia, in doses of one fluid drachm, diluted with half a wine-glassful of water, often arrests such vomiting like a charm. Creasote has a similar action, but possibly has some additional action on the nervous system, as it is useful even in cases where the vomiting does not appear to be due to decomposition of food. In dilatation of the stomach these antiseptics may fail, and the best results are obtained by washing out the stomach by a syphon-apparatus. *See* LAVAGE.

For the treatment of irritant poisoning, *see* POISONS.

When the mucous membrane of the stomach itself is inflamed or irritated, we must try to lessen the irritation. The best drugs for this purpose are ice, diluted hydrocyanic acid, opium, and bismuth. The insoluble salts of bismuth, and especially the subnitrate, are to be preferred to the solutions; and it is advisable to combine them with magnesia, potash, soda, or carbonate of lime, according to the condition of the intestines, preferring the magnesia when the bowels are confined, and carbonate of lime when they are too loose. Sometimes the tendency to vomit is increased by lying on the right side. This is probably partly due to the drag of the stomach itself upon the cardiac extremity, and partly to the difficulty with which gaseous eructations escape from the stomach in this position. When there is a tendency to vomit, therefore, the patient should lie down on the left side after a meal. In the vomiting of hepatitis, in addition to opium and diluted hydrocyanic acid, we may use ice-water, or ice swallowed, and leeches over the liver. In biliary calculus, we may give, along with opium, a full dose of ether internally, and in addition may employ ether or chloroform by inhalation; similar treatment may be adopted in cases of renal calculus.

In intussusception or hernia we must remove the cause, if possible. In peritonitis full doses of opium are best. For the vomitting in cystitis and ovarian diseases we must lessen the sensibility of the vomiting centres by the drugs already mentioned, and treat the local conditions.

In the vomiting of pregnancy we trust partly to the drugs already mentioned to act on the vomiting centre, and partly to local applications. It is sometimes arrested by the application of a 10 per cent. solution of nitrate of silver to the os uteri, or by slight detachment of the membranes around the margin of the internal os. Where all other methods fail, the induction of premature labour must be resorted to. *See* PREGNANCY, Diseases and Disorders of.

T. LAUDER BRUNTON.

VOYAGES.—*See* SEA-VOYAGES.

VULVA, Diseases of.—SYNON.: Fr. *Maladies de la Vulve*; Ger. *Krankheiten der Schamritze.*—The vulva or external genitals of the female comprise all the structures external to the hymen, having the navicular fossa and perinæum behind, the urethral orifice, vestibule, clitoris, and mons Veneris in front, and at the two sides the nymphæ and labia majora. These organs may be the seat of many diseases, which will be described in the following order:—

1. **Atresia Vulvæ.**—Closure of the genital fissure is sometimes found as a *congenital* malformation. This is usually of itself of no great importance, as it is almost always associated with other defects in development, as with atresia ani, hermaphroditisms, and extroversion of the bladder. *Acquired* atresia results from mismanagement of infantile vulvitis, from injuries of the pudenda in childhood, or from cicatrisation following upon some ulcerative process. It may give rise to trouble in micturition if the urethral orifice be involved. In rare cases it is only after puberty that trouble arises, from retention of the menses, or after marriage, from dyspareunia; or even during labour, from narrowness of the orifice delaying the escape of the infant. In the slighter and more recent cases, where the labia have only been agglutinated, they may be torn apart by pressure with the thumbs; or by passing a probe or sound behind the line of adhesion, and tearing it up with the handle of a scalpel, or with the nail. Where the union has become organised, the edge of the knife must be employed. In any case the patient should be anæsthetised; and care must be taken subsequently to prevent the reproduction of the adhesions.

2. **Inflammation.**—Synon.: *Vulvitis.*—Inflammation of the vulva may be (*a*) *general*; or (*b*) *localised.*

(*a*) *General vulvitis.*—This variety is found affecting the apposed aspects of the labia, and the whole of the mucous surface they enclose, up to the borders of the hymen. It may be due to gonorrhœal infection, in which case the catarrhal process is apt to extend to the urethra and the vagina. In infants and young children of strumous constitution, it sometimes arises from exposure to cold, want of cleanliness, or irritation from ascarides that have passed out of the anus. In the adult it may result from injury, or rude coition; or from the escape of acrid uterine or vaginal discharges. It shows itself with heat, and tenderness, or sometimes itching in the part; a discharge of viscid glairy mucus bathes the surfaces, which sometimes becomes purulent, and glues together the labia. When the labia are separated the seat of the mischief is exposed, and is seen to be red, and sometimes resentful of touch. Apart from the constitutional remedies that may be indicated in individual cases, the treatment consists in keeping the parts at rest, and carefully clean; and in bathing or douching the surface with hot water, followed by an astringent lotion or dusting powder.

(*b*) *Localised vulvitis.*—The vulvitis may be localised—(*a*) in the *vestibule*; (*β*) in the *navicular fossa*; or (*γ*) in the muciparous *follicles* and *glands*, and especially in the *Bartholinian glands.* (*a*) and (*β*) occur under the same conditions as the more diffused inflammation, and may be a source of considerable distress in walking or when the part is touched, without being attended by any leucorrhœal discharge. Such cases require the same treatment as cases of general vulvitis; only it is important to make the applications directly to the affected spot, and hence it is usually best to apply sulphate of copper in the form of a solid crystal. (*γ*) Inflammation in the Bartholinian glands is the commonest cause of *labial abscess.* It may attack females at any age, but is most frequently seen in women from twenty to thirty, whether married or unmarried. It may arise during pregnancy, and some women are liable to repeated attacks, the glands becoming swollen and cystic whenever the patient gets a chill. In some cases there is profuse secretion, which escapes freely. Far more frequently the swelling in the lining of the duct leads to occlusion. This occlusion is in some instances transitory, and when the swelling in the duct and around its orifice subsides, the secretion that had accumulated escapes. In other instances the duct becomes permanently closed. These are the cases where the patient acquires a swelling in the labium majus of the affected side, varying in size from a pigeon's to a hen's egg. The accumulated fluid may be clear and limpid; but often it is turbid and distinctly purulent. In all the suppurative cases, if the cyst be evacuated through a small opening, the fluid is apt to reaccumulate, and the cyst walls are now more likely to be the seat of a mischievous inflammation. So that the *treatment* consists, first, in trying to reduce the inflammation with hot fomentations or poultices, perhaps aided by sedative lotions containing belladonna or laudanum, with the view of getting the orifice relaxed; and where the contents do not escape through the duct, the cyst should be freely opened, and the cavity cauterised. Huguier's suggestion, to extirpate the gland, is not ordinarily required, especially if the evacuation be effected with a Paquelin's thermo-cautery, which first makes a large and safe cut into the cyst, and can then be applied to the interior, so as to destroy the secreting surface.

Specific inflammations.—The specific inflammations, *gonorrhœal* and *syphilitic*, are treated of in their respective articles. But it is to be noted that the vulva may be the seat of *erysipelas*; and female children have sometimes suffered from a gangrenous vulvitis or *noma*, of the same nature as the noma of the mouth and cheeks, which may come on after some of the eruptive fevers, such as scarlatina, and require the same kind of treatment, with chlorate of potassium and tincture of the perchloride of iron and stimulants, from an early stage of the mischief.

3. **Eruptions.**—Various forms of eruption may be met with in the vulva, sometimes on the nymphæ or internal aspect of the labia majora, sometimes on the external aspect, and extending to the mons Veneris, or inside of the thighs. The commonest are *eczema*, *erythema*, *herpes*, *prurigo*, and *acne*. They are diagnosed and treated in the same way as the same affections in other situations. It is to be remembered, however, that the tendency to chronicity, which is a marked feature of inflammatory processes in the sexual apparatus generally, is apt to show itself in these vulvar eruptions, and that patients, from motives of delicacy, are apt to allow them to remain untreated for too great a length of time. Further, many of them give rise to itching, which tempts the patient to rub and scratch herself to obtain relief, and may thus cause pruritus.

4. **Pruritus.**—ÆTIOLOGY.—Itching of the vulva is a not infrequent symptom of some of the eruptive and inflammatory affections of the part, either when these are healing or have got into a chronic stage; and it may remain as a permanent trouble after healing has taken place, if the patient have acquired the habit of relieving herself by friction. Sometimes it is reflex, from oxyuric irritation in the rectum, or when the worms have travelled from the anus to the vulva. Or it may be associated with disease of the vagina or uterus, as in cases of chronic colpitis or carcinoma of the cervix, in which the itching may either be due to irritation from the nature of the discharge, or be a reflex phenomenon. In some instances it can be traced to circulatory disturbance in the labia, as when the veins are enlarged, and in the congestion of early pregnancy. In others the renal secretion is at fault; and it is such a common phenomenon in women who are the subjects of diabetes mellitus, that in every patient who suffers from pruritus vulvæ, the urine should be tested for sugar. Lastly, there are some cases that can only be described as idiopathic.

SYMPTOMS.—The itching may be localised on the internal aspects of the nymphæ, or of the labia majora, or around the clitoris or the perinæum. In most cases of long standing it becomes diffused all around to the anus and inside of the thighs. Sometimes it is temporary, as in the pruritus of pregnancy, which passes off under careful management in a few weeks, or in rarer cases during the puerperium; in other patients it becomes chronic, and constitutes one of the most distressing troubles to which a woman is liable. The itching may come on only occasionally. For the most part it is likeliest to prove distressing when the patient is warm, as at bedtime, or after exercise; but with some the feeling is never quite in abeyance, and the patient has the almost constant desire to relieve herself, as for a time she can do, by scratching or, rather, rubbing the parts with her dress or a towel, until the pain overcomes the feeling of itch, or sometimes until the collapse consequent on the onanistic orgasm which she has involuntarily produced, renders her for a time less sensitive to her trouble. The result of such friction, however, is to keep up the local irritation; so that even in cases where there may not originally have been any local pathological change, but where the itching and friction have persisted for months or years, the skin and mucous membrane become thickened and indurated, and a condition resembling that of a chronic eczema becomes induced. In several cases the writer has seen epitheliomatous nodules develop at the sides of the clitoris and in the vestibule.

TREATMENT.—When diabetes mellitus is present it must be combated; and if the patient is gouty, or have her urine too acid or alkaline, these conditions must be rectified. Morbid processes that may be present in the vulva or other neighbouring structures must be treated according to the requirements of the case. A carefully regulated non-stimulating diet should be enjoined, and a due amount of exercise. The internal remedies that have been found most helpful are bromide of potassium and arsenic. Then, for the relief of the itching, the patient must be warned against the danger of rubbing the parts, and be taught to soothe it by bathing with very warm or sometimes with cold water, and drying the parts with a soft towel or napkin. It can be still better allayed by mopping with a lotion containing infusion of tobacco or belladonna or opium; or by applying afterwards a piece of lint soaked in black lotion, or a lotion of acetate of lead. The most effectual sedatives are ointments containing sulphur, camphor, tar, carbolic acid, thymol, iodide of lead, perchloride of mercury, bismuth, prussic acid, iodoform (deodorised with tonquin bean), or cocaine. In several otherwise intractable cases, patients in private practice and in the Buchanan ward of the Royal Infirmary of Edinburgh have been cured by ablation of the clitoris and surrounding mucous membrane, as far back as the vaginal orifice, and bringing the raw surfaces together by means of catgut sutures.

5. **Tumours.**—The following enlargements may be found in the vulva:—

(*a*) *Hypertrophy.*—The clitoris has sometimes been found of a size sufficient to cause discomfort, and warrant its removal. Far more frequently the nymphæ are of unusual dimensions, their margins projecting beyond the labia, and then they are liable to become the seat of ulcerative processes, and require to be trimmed, which may be done with the knife or scissors, but better with the thermo-cautery. Enlargements of the labia majora, in the form of elephantiasis, are met with among Hindu women. The mass is sometimes of enormous size, and in consequence of the calibre of the nutrient vessels, ablation is apt to be attended with dangerous hæmorrhage, so that the application of an elastic ligature is in most cases the best means of effecting its removal.

(*b*) *Hernia.* — Hernial protrusions may occur into the labia, and be found among the swellings of this part. The detection and treatment are to be effected and conducted as in the case of other herniæ.

(*c*) *Cysts.*—Cystic swellings are found in the upper part of the labia, when the canal of Nuck becomes the seat of an accumulation of fluid, which corresponds to hydrocele of the cord in the male; or lower down, when the duct of a Bartholinian gland has become occluded, and the secretion of the acini accumulates so as to distend the gland without its becoming inflamed. If a complete aspiration in either case is not followed by perfect cure, and the fluid reaccumulates, as it is apt to do, the second tapping should be accompanied with an injection of iodine; and in the case of the Bartholinian cyst, the wall of which is formed of a mucous rather than of a serous membrane, the evacuation may require to be effected through a larger opening, and followed by the application of a more powerful escharotic.

(*d*) *New-growths.* — Various neoplasms may have their seat in the vulva. At the orifice of the urethra not infrequently small red fleshy growths, the so-called *urethral caruncles*, make their appearance. They are sometimes unattended with any symptom; more frequently they cause intense suffering during micturition, during coitus, or when the patient takes exercise. The pain is usually referred to the urethral orifice, but it is sometimes reflected to distant parts, as to the heel. Relief from suffering may be temporarily obtained by application of sulphate of copper or nitrate of silver; but cure is only effected by removal of the growth. It is imperatively necessary to remove not only the small red body, but the portion of the urethra from which it springs, and the raw surface should be freely cauterised if the ablation have not been effected with a thermo-cautery. *Specific* swellings, warty or gummatous, are, of course, frequently to be met with on the vulva. *Lipomata* sometimes grow under the skin of the labia pudendi. More frequently *fibromata* occur, which may attain considerable size, and demand removal. Lastly, the law that *carcinomata* have a predilection for surfaces where a transition takes place from one variety of epithelium to another, is illustrated by the frequency with which different forms of cancer affect the vulva. Their development, symptoms, and treatment present no special features. Only it is well to remember that when the mischief is met with in a stage where there is still hope of its eradication, it is best to effect the removal of the neoplasm by some of the bloodless methods with which modern surgery has become familiar. The tissues in which the growth develops are very vascular; and whilst in some situations—as at and around the clitoris—it is comparatively easy to control hæmorrhage by pressure against the pubic bones, in the parts immediately to the side and back of the vaginal aperture the bleeding from a cut surface is apt to be uncontrollable and dangerous. Hence commencing carcinomata ought to be extirpated with the écraseur, or, better still, with Paquelin's thermo-cautery, which is the most serviceable of all instruments for the removal of the different varieties of neoplasm that infest the vulva.

Alexander Russell Simpson.

W

WAKEFULNESS.—*See* Sleep, Disorders of.

WARTS.—*See* Verruca.

WASTING.—A synonym for atrophy. *See* Atrophy, General; and Atrophy, Local.

WASTING PALSY.—A synonym for progressive muscular atrophy. *See* Progressive Muscular Atrophy.

WATER, Ætiological Relations of.—*See* Disease, Causes of; and Public Health.

WATER, Therapeutics of. — *See* Baths; Hydrotherapeutics; Mineral Waters; Sea-air, Sea-baths; and Temperature.

WATER BRASH.—A popular synonym for pyrosis. *See* Pyrosis.

WATER CANKER.—A synonym for cancrum oris. *See* CANCRUM ORIS.

WATER-ON-THE-BRAIN. — A popular name for hydrocephalus. *See* MENINGES, CEREBRAL, Inflammation of, Tubercular; and HYDROCEPHALUS, CHRONIC.

WATERS, MINERAL.—*See* MINERAL WATERS.

WAXY DISEASE.—One of the synonyms for albuminoid disease. *See* ALBUMINOID DISEASE.

WEAL, WALE, or WHEAL.—This is an old-English word signifying the mark of a stripe, that is, the prominent pale ridge caused by the stroke of a lash upon the skin. In Medicine the term is applicable especially to the prominent risings of a lengthened figure which are met with in urticaria, in contradistinction to the button-like tubercles or protuberances of that affection. *See* URTICARIA.

WEILBACH, in Nassau, Germany. Sulphur waters. *S*ee MINERAL WATERS.

WEN.—A popular term for a tumour of the integument, without reference to its pathological structure. Wens are commonly fleshy or encysted; in the latter case proceeding from distension of the sac or excretory duct of a cutaneous gland, more especially a sebaceous gland.

WESTON-SUPER-MARE, in Somerset.—A fresh, open, marine climate. Exposure W. Prevailing winds S.W. Mean temperature for the year 49·8° F. *See* CLIMATE, Treatment of Disease by.

WET-PACK. — *See* HYDROTHERAPEUTICS.

WEYMOUTH, in Dorset.—A bright, open, marine climate. Exposure E. Mean temperature for the year 50·1° F. *See* CLIMATE, Treatment of Disease by.

WHEEZING.—A peculiar sound, of a dry piping or whistling character, which may be heard in connexion with the respiratory organs during the act of breathing, and caused by certain forms of obstruction to the passage of air. *See* ASTHMA, SPASMODIC; BRONCHI, Diseases of; and PHYSICAL EXAMINATION.

WHIFFING.—A peculiar quality of a murmur heard in connexion with the heart and vessels. *See* HEART, VALVES AND ORIFICES OF, Diseases of; and PHYSICAL EXAMINATION.

WHIP-WORM.—This term is not infrequently applied to the small human nematode that is better known to the profession as the *Trichocephalus dispar*. *See* ENTOZOA.

WHISPERING PECTORILOQUY. A form of pectoriloquy in which the whispered voice is distinctly heard. *See* PECTORILOQUY; and PHYSICAL EXAMINATION.

WHITE GUM.—A popular name for the white form of strophulus, *S. albidus*. *See* STROPHULUS.

WHITE LEG.—A common name for phlegmasia dolens. *See* PHLEGMASIA DOLENS.

WHITE SWELLING.—A common name for scrofulous or tuberculous disease of a joint. *See* JOINTS, Diseases of.

WHITES.—A common name for leucorrhœa. *See* LEUCORRHŒA.

WHITLOW.—SYNON.: Paronychia; Fr. *Panaris*; *Tourniole*; Ger. *Paronychia.*

DEFINITION.—Whitlow is a term somewhat loosely applied to any acute inflammation of the finger or thumb which tends rapidly to terminate in suppuration, and is not limited to the matrix of the nail, in which case it would be called *onychia.*

Whitlow may be divided into four chief varieties, but these often merge into one another: (1) Paronychia Ungualis; (2) Paronychia Cellulosa; (3) Paronychia Tendinosa; and (4) Paronychia Osseosa.

1. **Paronychia Ungualis.** — SYNON.: Superficial Whitlow of Abernethy.—This form is limited to the ungual phalanx. The skin only is affected, and frequently at the side of the nail. It commences usually as the result of some slight injury, such as a bruise or puncture, or from the inoculation of septic or other irritating matter. The first signs are heat, tenderness, and itching in the inflamed part. The pain is not severe. On the third or fourth day pus forms, raising the epithelium from the cutis vera. As the pus cannot point through the dead cuticle, it remains pent up, and the tension so caused increases the pain, and if unrelieved leads to further ulceration of the true skin, the pus then finding its way into the cellular tissue beneath. The whitlow then merges into the second variety. It may also spread to the matrix of the nail, and so become complicated with onychia. If relieved early, by cutting away the cuticle which has been raised by the pus, it seldom leads to any unpleasant consequences.

TREATMENT. — The treatment consists in bathing the finger frequently in hot water, and applying lint soaked in hot water, which is cleaner and better than a poultice. A combination of equal parts of glycerine and extract of belladonna will be found an invaluable application, frequently cutting the inflammation short, and always relieving the pain. As soon as there is any sign of the cuticle being raised by fluid beneath, it should be cut away with a pair of scissors, or a razor or sharp knife. An incision is never necessary.

A form of superficial whitlow is sometimes seen occurring without any apparent cause, and attacking one finger after another. The fluid beneath the cuticle is not always purulent —sometimes being merely albuminous, and mixed with flakes of lymph. It never leads to any deep suppuration. It is most common in children and females, and is consequent upon general debility. It is described by the French under the name of *tourniole* or *panaris phlycténoïde*. It is a troublesome affection, and difficult to get rid of. Tonics and iron are the most important remedies. Sometimes arsenic is of use.

2. **Paronychia Cellulosa.** — The inflammation in this variety commences in the cellular tissue of the pulp of the ungual phalanx. It arises almost invariably as the result of some slight puncture or other injury, or as the consequence of neglecting the variety just described. The tip of the finger is swollen, tense, and excessively tender. There is severe burning, throbbing pain; and possibly red lines are observed spreading from the inflamed part in the course of the lymphatics. There is more or less fever, with general constitutional disturbance. Pus forms by the third or fourth day. It tends to point through the skin, but the thick cuticle usually resists its pressure for some time, and if this be not cut away early the gravest results may ensue. The pus may find its way into the sheath of the flexor tendons; or the bone may be exposed, and necrosis may follow, the disease then merging into the two following varieties. If an incision be made about the fourth or fifth day, a large slough will usually be found beneath the skin.

TREATMENT. — A free incision must be made longitudinally into the pulp of the finger as soon as the condition is recognised, and by this means all complications will be averted. If the pus have already found its way through the cutis, and be pent up beneath the epidermis, it is often sufficient merely to cut away the loosened cuticle with scissors. In other respects the treatment is the same as for the first variety.

3. **Paronychia Tendinosa.**—SYNON.: Thecal Abscess. — This is usually classed with whitlow, and is often secondary to the other varieties. It frequently begins, however, as a primary inflammation of the sheath of the flexor tendons. It is supposed by some to be related to erysipelas, and in many cases it probably is so; but frequently its cause is uncertain. It may arise from a wound opening the sheath of the tendon, but then would hardly be called a whitlow. The whole finger swells, and becomes tense and red. The pain is most severe, usually shooting up the hand and arm. Pus forms early, and, if not evacuated by incision, exposes the bones, destroys the tendons, burrows into the joints, and rapidly destroys the finger. If affecting the thumb or little finger, the sheaths of which are continuous with the common sheath at the wrist, the suppuration rapidly extends to the palm of the hand, and to the forearm above the annular ligament. The wrist-joint may then be opened, and destruction of the whole hand result. The constitutional disturbance and fever are usually very marked. The disease is most common after middle life, and in patients of a broken constitution. The affected finger or hand seldom recovers perfect utility; and death is not uncommon, either from exhaustion or from some secondary complication.

TREATMENT. — Hot baths to the hand, fomentations and poultices, and free and early incisions are required. Glycerine and extract of belladonna is a most useful application. Stimulants, good diet, and tonics are always necessary.

4. **Paronychia Osseosa.** — This is a comparatively rare variety of whitlow, arising sometimes from injury, sometimes without apparent cause. It is an acute inflammation of the periosteum of the ungual phalanx. It is characterised by redness and swelling, with most intense aching and tensive pain, and acute tenderness. If an incision be made as soon as pus is recognised, the bone will be found to be already bare and necrosed. This condition can only be averted by cutting down to the bone before suppuration has occurred, and this is rarely possible.

TREATMENT.—This is the same as in the other varieties, namely, hot applications and free incisions. The necrosed phalanx must be removed as soon as it is loose. If more than one phalanx be affected, amputation may be necessary.

One or two points common to the treatment of all varieties of whitlow require further notice. All incisions should be made as far as possible in the middle line, so as to avoid wounding the digital arteries. The sheath of the flexor tendons should on no account be opened, unless there is pus within it. In all doubtful cases an anæsthetic should be administered, the limb made bloodless by Esmarch's method, and the incision carried carefully towards the flexor tendons. In this way the exact situation of the pus can with certainty be ascertained, and an unnecessary wound of the sheath of the tendon avoided. Incisions are frequently made into the pulp of the ungual phalanx of the finger when the pus is really on the dorsum. This arises from the sense of fluctuation yielded by a swollen finger covered by somewhat thick cuticle. In all cases the cuticle should be cut away as soon as it is loose, and not allowed to hang about in shreds caked with putrid pus and linseed meal. The best application in all cases is boric lint, three or four layers thick, wetted with hot water, and covered by oiled silk and cotton wool. This is perfectly clean, and in every way as efficient as a poultice. Soaking the hand frequently for an hour at a time in an arm-bath usually gives great relief in the more severe forms. MARCUS BECK.

WHOOPING - COUGH. — SYNON.: Kin-cough; Hooping-cough; Pertussis; Fr. *Coqueluche*; Ger. *Keuchhusten*.

DEFINITION.—An infectious specific disease, chiefly affecting children, lasting six or eight weeks, rarely attacking the same person twice, and accompanied by a peculiar spasmodic cough. The cough, not characteristic till the second week, comes on suddenly with quick, short, forcible expirations, and flushed face; then a long, shrill inspiration, or whoop occurs. Several of such coughing efforts in repeated paroxysms follow, the attack ending in the expulsion of viscid mucus, or in vomiting. A return of cough is readily excited for some time after the disease has subsided.

ÆTIOLOGY.—Infectious particles thrown off by the cough, and carried to the air-passages of the susceptible, there fixing and multiplying, set up the same series of disturbances by which they are produced, and reproduce abundantly more infectious material. Whooping-cough occurs in epidemics, chiefly prevalent in the spring, extending over a large part of any town or district associated by various means of intercommunication, such as common educational establishments; and it spreads as long as young children who have not had the disease before are brought within its influence. For a disease of this kind, attacking the respiratory surfaces, and there exciting a specific secretion, with violent cough to scatter it, a more widely diffused air-borne infection might be imagined than for other infectious diseases; but there is no proof that such infection is ever carried across any wide distance. What the limit may be for such transportation is quite uncertain: a child at school commonly takes it near at hand, as from another in the same class; in crowded tenements all are not seized at once.

From the reception of infection to the evidence of its effects, an interval for incubation always intervenes. When children are said to have been attacked soon after exposure to keen air, this has only roused into activity a cause already in operation. Some quality of the air or season may act as a predisposing cause. Certain bodily states—the condition of teething, and that left after measles and some other diseases—predispose the mucous surfaces to receive and foster the germs of whooping-cough. This infection is often received with that of measles, and the characteristic cough of the one disease is not recognised till the rash of the other has passed away. Three weeks may elapse before children, who have been exposed to infection, show signs of it by the whoop; they, therefore, should not mix with others who are susceptible till this period is safely over. Infection persists for six or eight weeks after the disease is declared; after this there may be a return of cough or spasm without fresh danger of infection. During the illness any bit of mucus thrown off by the cough may be the medium of infection; whether other secretions are infectious is a matter of doubt, but emanations from the sufferers may be so, even after death. The disease is readily propagated by *fomites*. It is frequently carried from house to house by the clothes of visitors. The sick create an atmosphere around themselves into which the susceptible cannot enter without danger of being seized; a portion of this atmosphere is easily removed and carried in the folds of dress to other houses and rooms. Some infectious particles cling to the clothing of convalescents for a long time. Active infection is given off by those affected slightly, or only beginning to be so while sickening for the disease; even the insusceptible, who are not liable to suffer in the same way again, may have slight cough or irritable throat after being with the sick, and so, ailing little or nothing themselves, be the means of carrying infection elsewhere.

Whooping-cough prevails so extensively in early childhood, that it is rare to find anyone grow up without having been exposed to it. Those who escape infection in childhood mostly escape it altogether. Adults are rarely seized. When this happens—and no age is entirely exempt—the disease goes through its full course with the same symptoms, and the same instinctive dread of recurrent spasm, as in infancy, but with none of the dangers then arising, only with the vexations of a tiresome and embarrassing ailment.

The greatest number of cases occur in children under eight years of age. It is one of the three diseases most fatal to young infants, and, like the bronchitis of cold weather, and the diarrhœa of summer, is most fatal to the youngest; it differs from these in not being more fatal either in very hot or in very cold years. Whooping-cough comes next to scarlet-fever in the number of deaths attributable to it in this country, the proportional mortality from this cause being five or six per ten thousand of population, and nearly 2·5 per cent. of yearly deaths from all causes. Three-fourths of all the deaths from it are of children under two years of age. Sex has a marked influence on the fatality of whooping-cough. Girls suffer more than boys. While half the attacks of boys are severe, five-sixths of the attacks among girls are so; the deaths of girls being nearly one-third more than of boys. Race and climate make little or no difference as to the liability to whooping-cough. Season has an influence on its epidemic extension; this in Great Britain is always in the spring. Cold indirectly adds to the intensity of the disease; it is increased by overcrowding, bad ventilation, and the confinement of the sick in close apartments. The bad effects of whooping-cough are most marked in the rickety.

The period of incubation is well-marked in all cases, and extends from four days as the shortest limit, to ten days or a fortnight as the longest; in the latter instance, a solitary one, no catarrhal symptoms were noticed till thirteen days after a single limited exposure, the whoop appearing ten days after that. Three weeks must elapse after exposure to infection before we can say the disease has been escaped. Usually some catarrhal and febrile symptoms, with or without cough, appear from the fourth to the seventh day after exposure to infection. The invasion, or catarrhal, stage lasts a week. The whoop mostly begins ten days from the ingress, unless accidentally delayed; it has been heard as early as the eighth day, or as late as the twenty-fifth and even later, or not at all. The complaint has not been directly produced by inoculation.

Pathology and Anatomical Characters. The course and duration of all the symptoms of pertussis are too constant and definite for the cough and other results of the disease to be deduced from the effects of any kind of local irritant on the mucous surfaces of the air-passages. A specific catarrh with hyperæsthesia is admitted by all. Is this located chiefly in the bronchi (Broussais and Guersant); limited in the first instance to the laryngo-pharyngeal mucous crypts (Gendrin); or confined within the larynx (Beau)? The last view is supported by the redness seen extending from the epiglottis to the vocal cords; and by the tumefaction, and viscid or puriform secretion, found in the larynx after death. But the larynx may redden only when the cough begins, and this may be excited by mucus rising into the trachea from below as well as by that touching the glottis from above, and the bronchi may be affected before the larynx. A fit of coughing may also be excited by bronchial or gastric irritation, and by emotional disturbance. As neither laryngitis nor bronchitis in children is attended with persistent spasm, a cause for this has been sought in the swelling of the bronchial lymphatic glands so often associated with spasmodic cough. This source of reflex excitement of the vagus is applied by the late Dr. Noël Guéneau de Mussy to explain the recurrence of spasm long after the usual term, rather than advanced as an explanation of the character of the cough throughout the disease; he suggested, however, that the absence of spasm from the first stage of the disease, or its delay, may be from the bronchial glands not being very much enlarged in such cases. The small lymphatic glands in the neck and along the trachea and bronchi are affected early, both in this disease and in measles; their enlargement is much less marked in adults than in children, yet adults have the same spasm in the second stage of whooping-cough; and in the serious pulmonary lesions after measles children have not the same kind of cough. The explanation of this difference is in the specific or contagious element. In ordinary catarrh or bronchitis the spasm yields when secretion begins. Here the same contagious matter that began the irritation not only keeps it up by local increase, but, multiplying vastly for a certain time, is thrown off by the surfaces where it proliferates, or to which it is carried, perhaps with added virulence and activity. A less permanent, less energetic, or less extended irritation of all the sensory terminations of the pneumogastric nerve would not so excite and increase the susceptibility of the nerve, while diminishing and exhausting its power, nor thus modify the nutrition and function of its centre; the change so impressed continues long after the original exciting cause has ceased. A special influence may from the first be attributed to the specific cause. A certain degree of hyperæmia would determine fever, distend the lymphatics, and excite cough by irritation of the peripheral nerves. But the nerve-centres, both of the respiratory and sympathetic system, are disturbed in the earlier stages, and the vagus is specially implicated before the enlarged bronchial glands or other local causes of excitation are established. The impaired function of the pneumogastric is shown by the rapid and weak pulse, epigastric tenderness, loss of appetite, weak respiration, and pulmonary congestion; this aids the impulsion of morbid products to the bronchial surface, hence a specific secretion and a further source of reflex irritation, hyperæsthesia, and the special characters of the cough. The spasmodic cough is sometimes suppressed during an intercurrent fever or pneumonia, and returns as these conditions subside. The element of contagion, whatever it may be, is reproduced abundantly in this catarrhal secretion for a definite time, after which it does not reappear; the cough or spasm may return for months, but no real relapse of the disease. One attack is protective against a recurrence.

The disease then is zymotic, and essentially neither a neurosis nor a bronchitis, though both of these conditions are excited by it. Zymosis may be either by a local proliferation, or a general infection, or both; it has been thought sufficient, by those who incline to view this and some allied diseases as local, for contagia acting upon the mucous membrane to entail all the consequences of the disease in the former mode only. On the other hand, bacteria, as seen by V. Potain, and micrococci described by Letzerich as infective, abound in the secretions, penetrate the cell-structures, and are found in the leucocytes of the blood and tissues. These differ little, if at all, from those of ordinary occurrence, except in their number and rapidity of increase. It is unlikely that the common forms could acquire special quality from accidental inflammation around them; but these, derived from a special source, may carry with them special qualities setting up the same action in a suitable medium, as that in the tissue from whence they were derived; they permeate freely, and the process has ceased to be local before the signs of disease are observed. The part taken by the white corpuscles of the blood, as carriers and destroyers of infective germs, cannot be overrated.

As in the exanthemata the rash shows impaired vaso-motor nerve-control in the skin, so in whooping-cough the irritability of the surface of the pharynx, glottis, and trachea is early evidence of disturbed innervation. There is no deep-seated congestion of the fauces; the catarrhal state is more marked below the glottis than above, the trachea is often pale, the bronchi are always congested, and the smaller lymphatic glands along their course and beside the trachea, as well as the larger bronchial glands, are constantly red and swollen, so as to be pathognomonic; later, these or the mediastinal glands may show centric softening. The bronchial membrane is thickened, red, and covered with sticky masses of secretion, in which groups of micrococci are found; the viscid secretion in the smaller bronchi is an almost constant condition, and some of this drawn into the pulmonary alveoli affords a prominent character of the disease; such blocked alveoli look like tubercles under the pleura; if punctured the contents will squeeze out. Ecchymoses are seen on the pleuræ, and sometimes in the pericardium. The œsophagus is pale, but the mucous membrane of the stomach is often swollen and red, with punctiform injection or petechial spots; effused blood has been found in the bowels; a follicular inflammation of the intestines is associated with gastric catarrh; and there is some enlargement of the mesenteric and retro-peritoneal glands. The liver is more often hyperæmic than the spleen, with some fatty cells; or is large, with yellowish-grey fatty change in the tuberculous or rachitic. There is no definite kidney-lesion. Cerebral effusions, like chemosis or œdema of the face, are the accidents of cough and dyspnœa. Spasmodic cough is not merely a reflex from the upper laryngeal nerve. Shallow respiration and insufficient oxygenation excite respiratory efforts; but, as less air gets to the blood, expiration is accentuated, and goes on in a convulsive repetition, due to the stimulation of the medulla by the venous blood. This happens on any interference with the supply of oxygenated blood to the respiratory centre. From these severe efforts exhaustion results. When the centre recovers its excitability, inspiratory effort follows; and on the rapid alternations of these states much of the frequency, force, and duration of the paroxysms depends. Repeated distension of the right cavities of the heart in the fit causes various venous hæmorrhages. Obstructed air-cells, catarrhal pneumonia, and lobular collapse of lung, with surrounding emphysema, also occur as secondary phenomena. These, with cerebral congestion, result from futile cough. Impeded respiration leads to convulsions in children; epileptiform seizures have resulted from miliary aneurysms or hæmorrhagic spots in the brain and spinal cord; but most of the cerebral symptoms during the illness are indicative of some further mischief in the lung. In rickety subjects these complications, together with the greater tendency to spasm in this diathesis, produce bending-in of the ribs and contraction of the chest, often interfering greatly with healthy development in later years.

SYMPTOMS.—The invasion of whooping-cough is insidious, rarely with chills. Some fever or cough is first noticed at night; the child is better next day, but loses appetite, is fretful, or looks pale and languid. The pulse is quick, and the respiration shallow. There may be sneezing or signs of catarrh, but these mostly appear after another night of fever, or of teasing, frequent cough, which may be croupy before secretion begins; the glandulæ concatenatæ are perceptible to touch. Instead of a freer secretion soon following and relieving the symptoms, as in ordinary catarrh, the cough increases; there may be high fever, with pulmonary congestion, or the fever subsides, and bronchial *râles* are heard on deep inspiration. This is known as the *catarrhal* or *premonitory stage.* It lasts eight or ten days, the whoop being seldom heard till the end of the second week. But the period is not definite, for the fever of this, as of the other two stages of whooping-cough, is marked by great irregularity, with intervals quite free from fever; in this stage it may be prolonged by various complications, or be very little noticeable. In the latter case the cough is sooner distinctive; it comes on in fits, mostly at night; in the day there are intervals without cough. When the cough is coming, the child's face reddens, as if trying to suppress it, till it bursts out in a series of short, quick, forcible efforts; then the breath is drawn in with a shrill whistling sound, again followed by the boisterous cough; after a short pause comes a less severe and shorter fit, and then another, till a quantity of whitish viscid mucus is expelled, some perhaps through the nose, and some swallowed, or the child vomits at the same time, ejecting the contents of the stomach.

When the secretion is free, the catarrhal stage merges into the *spasmodic stage.* At this time laryngoscopic observation has shown the mucous membrane pale to the lower third of the trachea; a little mucus secreted in the larynx has been seen to excite cough; or the entire surface of the larynx and trachea was catarrhal. Again, before the cough, whitish mucus has been seen to rise to the bifurcation of the bronchi; then cough begins; some time after it is over, the vocal cords have been observed to be redder than before. Bronchial catarrh is as much a feature of this stage as the spasm. When the cough seems to have come on without cause, the secretion has risen to the trachea; children are often old enough to describe a tickling in the throat before the cough, they show dread of its approach, and prepare for the attack, by steadying themselves, or clinging to others for support; they are glad when it is over, and seem afterwards cheerful in the day, and go to sleep again at night. Not so with younger children; before the attack the pulse quickens, the breathing is short and insufficient, *râles* are heard, spasm closes the glottis, the air is forced out in sudden jerks, and then enters with the loud long-drawn whoop; this is repeated till the face becomes livid and swollen, and the child exhausted or semi-conscious. Frequent attacks of this kind keep the face puffy; they force the tongue over the lower teeth, and produce small ulcers on the frænum linguæ, or make the eyes red and watery, often with small hæmorrhages into the conjunctivæ. In the paroxysm blood may start from the nose and mouth, or be seen in the matters vomited, while both urine and fæces may be passed involuntarily. In some cases diarrhœa and vomiting are serious symptoms. While the cough forces air from the lung, the percussion note is dulled, and becomes again resonant after the sibilant inspiration is heard. The heart's action is impeded, sometimes interrupted by the passive congestion reacting on its cavities during the cough, or from irritation of the vagus; neither endocardial nor pericardial lesion is found in whooping-cough, and nothing is found wrong with the heart after the fit is over.

Examination of the chest in the intervals of cough reveals the usual signs of whatever pulmonary complication is present. In most cases a mucous rhonchus is heard over the larger bronchi, and some finer rhonchi on deep inspiration, with weak respiratory sounds; moist or dry crepitation replaces these in places where the finer bronchioles or alveoli are affected; this may occur without much capillary bronchitis or pneumonia; hence at the same time very varied or 'patchy' thoracic signs are found, resonant or dull in parts. Violent spasm prevents air entering some of the smallest tubes; the epithelium thus loses its cilia, and, mixed with mucopurulent secretion, blocks a small lobule or fills an alveolus; this happens when the fits of cough are worst and most frequent; with closed glottis the forcible expiratory efforts compress the contents of the alveoli, and squeeze out the fluid parts, leaving the *débris* to caseate; a dry crackle, rather than moist bubbling *râles*, may be indicative of this. Meanwhile air in some peripheral lobules, compressed in the same way, gives rise to vesicular emphysema with partial collapse; this state of lung can recover itself sooner than the other. A more extensive capillary bronchitis or catarrhal pneumonia is shown by grave general symptoms, restless tossing, rapid breathing, dusky face, coma, and convulsions. Pleurisy is not rare, and may result in empyema.

Without these complications, the *third stage*, of subsiding spasm and loose expectoration, with returning health and strength, may be reached in from four to six weeks. The mildest cases may seem to be over sooner, with one week for the catarrhal stage, and two for the spasmodic; but any little want of care will intensify the symptoms; and relapses are common until six weeks are accomplished, even in cases where the second stage has not been prolonged beyond four weeks. The disease often lasts two months, and is followed by a tedious convalescence. The pulmonary deposits may lead to tuberculosis. The disturbances of nutrition and innervation are long in being restored.

Diagnosis.—Influenza has dry, frequent cough, paroxysmal, and worse at night, with gastric and febrile symptoms, hardly distinguishable at first from those of the ingress of whooping-cough. But influenza prevails as a widely spread epidemic, not limited to children only and to a particular neighbourhood, but affecting persons of all ages; there is more coryza; it has a crisis in five days, and is mostly over in ten days, though relapses are frequent; the same persons are attacked more than once, sometimes even in the same epidemic. In children, if cough persists, it is without whoop; the conjunctivæ may be red, but have no blood-effusions; no small ulcers form under the tongue. Bronchitis comes on in cold weather directly after exposure or chill; the breathing is quickened from the first, while in the early stages of whooping-cough the respirations are often either slow or shallow. Infantile laryngitis also has no stage of incubation: laryngeal diphtheria has no remissions. Both alter the voice and cry. Some catarrhal attacks among children, coming on with fever, often with laryngeal irritation, and with fulness of the small cervical glands, are less readily recognisable; in either case if the breathing at first be less quickened than the pulse, this difference ceases as soon as lung-mischief begins. Children rarely spit up phlegm in common cough; the specific secretion of this one when freely expelled comes too late to be a useful guide. An opinion can only be given after some delay and caution, unless, as is also the case with measles, the child is known already to have had these diseases. A first question is, What infantile ailments are over? the next, What have been the chances of exposure? Hay fever occurs in the summer, mostly in adults; it attacks certain people only, and these every summer; if the first attack were supposed to be whooping-cough, the mistake could not be made a second time. The spasmodic cough of hysteria is incessant, and without whoop; it is only contagious by imitation.

Prognosis.—Young children under defective hygienic conditions, or the subjects of rickets, are least likely to make the favourable recovery generally expected in uncomplicated whooping-cough. Many young infants die from laryngeal spasm, sometimes in the earlier stages of this cough, but mostly in the second stage, when it is readily excited both by pulmonary causes and by bad ingesta. With good sanitary surroundings and individual care the youngest may escape, unless debilitated by previous illness, such as measles, or a defective state of nutrition at the time of the attack. The risks diminish with each year of childhood, excepting that the impaired resistance of the chest-walls in rickets may place a child of seven much in the state of another at two or three years old. Constitutional defects, or the accidents of nurture, may lead to wasting diseases which begin in the third stage, and prove fatal some time after, or at any age. High fever during invasion is a warning of severe complications in the subsequent stages. Convulsions in any stage of whooping-cough are of the worst significance; somnolence, or a listless condition between the attacks, and persistent high temperature, are bad signs. The danger of the second stage is in proportion to the severity of the spasm. It may be estimated by noting the number of attacks in the twenty-four hours, their intensity, and duration; in bad attacks the expulsive efforts are more rapid, and there is a shrill or repeated whoop; in mild attacks there is less spasm, and the whoop is not always heard, or perhaps only once. The duration may be from a few seconds to some minutes. The number of attacks may be raised from twelve to twenty in the twenty-four hours without danger, if the intervals are complete enough for the child to seem bright and take food in the day, and to get sleep by night; as many as 60 to 80, or even 140 have been counted; they may be so incessant as to interfere with both food and sleep, and are then very exhausting. When the nutrition is enfeebled, and the tongue often protruded over the teeth in violent cough, small ulcers are found; they are proofs of the severity of the spasm, and mostly indicative of a danger that is over. Capillary bronchitis and pneumonia are the complications most often fatal; œdema of the glottis or of the lung surely so, but these conditions are rare. Chronic pneumonia is apt to result in dilated bronchi, or in phthisis. Emphysema tends to disappear. Partial collapse may largely recover itself on air regaining admission to the lobule. Blocked alveoli set up a circumscribed pneumonia; their contents caseate; and tuberculosis results from these centres, or from degeneration of the enlarged bronchial and mediastinal glands. Tubercular meningitis and acute tuberculosis during or after the third stage are rapidly fatal.

Treatment.—We have no specific for whooping-cough: no drug to check its onset or stop its progress. The disease is of long duration; the patient a child. Hygienic conditions must be observed, and means used to prevent distress, reserving the more active remedies for special occasions. Rest and warmth, with much individual care, and the utmost attention to a sufficiency of pure air, are requisite from the first, and indeed throughout the illness. It is not merely exposure to cold, but fatigue and injudicious food, that determine the accessions of fever so frequent in the course of whooping-cough. These accessions have always with them an increase of the germs of the disease, more as a result than as a cause of the fever; they are better lessened or prevented by whatever aids the resisting powers of the child, than by close cosseting, or the use of special germicides, except as a means of freshening the air of the room; an aggravation of all the symptoms follows the confinement of one or two sufferers to a single chamber. The diet is to be light and nutritious, milk forming an important element in the meal, and some addition to the ordinary food has often to be sought, whilst all things hard of digestion or irritating are to be avoided. Broth should be made with vegetables and without condiments; stewed fruit, orange juice or lemon, and grapes are grateful; some extra diluent is always requisite. Each child wants a good deal of ready assistance; some one should be near to subdue fright when the cough begins, and to raise and hold the child till the fit is over.

In the *catarrhal stage*, if the ingress be febrile, a day in bed may be right. The child is better indoors till this stage and the next are over. Whatever moderates catarrh lessens the force of the attack, and fresh catarrh increases it. The room must be changed two or three times a day, so that one is thrown open and freshened while the other is occupied, and then closed and warmed, in its turn to be ready for use. Some simple saline, as solution of acetate of ammonium, may be required, or ammonia in any dilute form. A sip of cold water often relieves cough, but at night some ipecacuanha will be needed; a teaspoonful of the wine, mixed with an ounce or two of sweetened water for the night, can be given by spoonfuls till the cough either lulls or ends in sickness. The bromide of potassium or ammonium in repeated doses, gr. iij–v. to the spoonful of water, gives relief at night in this stage, though more suitable to the next, when antispasmodics, of which chloral hydrate is the chief, are most wanted. Neither opium, chloral hydrate, nor belladonna is to be used till the first stage is over, and secretion is free; nor while there is any local congestion or other source of irritation to be removed. A warm poultice of crushed linseed across the back of the chest is often of the greatest use when the cough is teasing, and should always be applied if fine *râles* be heard, or if there be deficient expansion over any part of the lung. The first extension of bronchitis to the finer tubes excites bad spasm, for which a few small doses of any antimonial may be proper, if the child be robust and plethoric. In most cases ipecacuanha can be continued in small doses for some time; the emetic dose at night often soothes by emptying the stomach; this relief must not be sought too frequently, though children's stomachs soon recover from this effect of ipecacuanha after a sleep. The bromides of potassium or of ammonium can be continued throughout all the first and second stages with advantage. A solution of carbolic acid, two or three grains to the ounce, may be beneficially given to children at the end of the catarrhal stage. When secretion is free the compound tincture of camphor can be added to the ipecacuanha wine, one part to two for young children, two parts to one with chloroform water in adolescence. Some of the soothing effect of spraying the solution of carbolic acid with a small steam vaporiser in a room may be from a part being absorbed. In very many cases of whooping-cough no medicinal treatment is needed, but there are others in which the child is obviously ill with more than the usual fever; or, just when amendment is expected and a freer secretion should come on, there is an increase of fever, with no marked complication. In these cases quinine should be given; one grain *per diem* in powder for each year of age, continued for two or three days only, answers best; double this quantity at a single dose, and that repeated, has been given with good effect during the first four or five days of the spasmodic stage. Some priority in the use of quinine and of chloral hydrate may be claimed by the writer. One great advantage in the use of both these remedies is that they can be given in enemata, either nutrient or stimulant.

Relief of spasm is the main object of treatment in the second or *spasmodic stage* of whooping-cough, the efficacy of the means employed being measured by the diminution in the number of daily attacks. By this test belladonna often proves to be useful if given in large and continued doses; with a child of three years old, one-sixth to a quarter of a grain of the extract, or ten to fifteen minims of the tincture, may be reached before the pupil is dilated; atropine, divided into doses of one-hundredth or one-eightieth of a grain with sugar of milk, or as drop doses of the sulphate-solution, is a more certain way of getting the effect required, and of regulating the quantity necessary to produce it. Minute doses of morphine (one-sixtieth of a grain given with the atropine, or small doses of any opiate with belladonna) answer better than if given uncombined; but this addition is only permissible when the secretions are free, and the means of relief do not require frequent repetition; opium is most useful near meals when food is ejected with the cough. The liquid extract of ergot, one drachm a day, given in divided doses to children for two or three days, is said to control spasm. Phenazone, cautiously given, is of service in some cases. Butyl-chloral hydrate, in doses of one or two grains in weak solution, or disguised in powder, given to children three or four times a day, lessens the force and frequency of the spasm. Bromoform has been recommended by Dr. Burton-Fanning, in doses of half a minim to three minims, cautiously, according to the age of the child, three times a day. Bromide of ammonium is often all that is required, but there may be need of chloral hydrate. Most of the remedies vaunted for cure of whooping-cough owe their repute to having been administered in the fifth or sixth week of illness, when other agents are said to have failed, and the disease is nearly over. Frictions across the back and chest with an oily liniment, to which oil of amber is often added, or with belladonna and opium liniments combined, are useful. Where cough persists from pulmonary complication, hot poultices repeated, perhaps with a little mustard added to one of them, give more relief than any frictions. All the more potent means of counter-irritation, such as croton oil or blisters, are to be avoided; so is the application of leeches to the head or elsewhere.

In the *third stage* of whooping-cough some astringents are often of great use; and restorative means are much wanted. Alum is of decided benefit when excessive secretion is troublesome, one grain to a drachm of liquid. Much harm is done by sending children out for play or change of air before convalescence is secure. Where the illness requires continued rest in bed, not only should the room be changed, but the one left is to be fumigated either with sulphur or cresolene before being made ready for the patient's return. A solution of carbolic acid, six or ten grains to the ounce, may be used in a steam vaporiser at intervals while the room is occupied. Resorcin, one grain to the drachm of water, can be used in spray or applied directly to the larynx with benefit. One or two grains of oxide of zinc may be given three or four times a day in powder; or half a grain of the sulphate in solution. An emetic may be required, to remove excess of mucus; sulphate of zinc, one to five grains, can at this time be added to the ipecacuanha, which alone is best for the earlier stages when emesis is more often required. Some aperient is often needed throughout the illness; strong purgatives are at no time advisable. A drop of laudanum before food stays sickness. The mineral acids make an agreeable aid to digestion. Cinchona bark or iron and cod-liver oil may be required. Minute doses of arsenic with meals, and iodine externally over small spaces on alternate days to back and front on either side, counteract obstinate adenopathy. Change of air has a remarkable effect in restoring appetite, and removing spasm, after the disease is quite over; it should not be sought before six weeks, and is often better deferred till two months from the commencement of illness. If the tubercular diathesis have been set up or evoked, the greatest care in nursing, and the most perfect quietude, are essential. Great risks, without benefit, have been run by taking children to gasworks during the course of the complaint. Attempts to cut short the disease by inhalation or insufflations of germicides fail. An equable, pure air around the patient shortens the illness and lessens its severity. Antiseptics added to the liniments used, or to the vaseline for the head, may do good in this way. Sanitas, or a solution of permanganate of potassium or of peroxide of hydrogen placed in the room, on cloths near the child's couch, or sprinkled about, are of use by purifying the air.

William Squire.

WIESBADEN, in Nassau, Germany.—Thermal salt waters. *See* Mineral Waters.

WIGHT, Isle of.—*See* Sandown; Shanklin; Undercliff; Ventnor; and Climate, Treatment of Disease by.

WILDBAD, in Würtemberg, Germany. — Simple thermal waters. *See* Mineral Waters.

WILDUNGEN, in Waldeck, Germany. — Earthy waters. *See* Mineral Waters.

WINDPIPE, Diseases of. — *See* Larynx, Diseases of; and Trachea, Diseases of.

WINKING, INVOLUNTARY.—*See* Facial Spasm.

WINTER-COUGH.—This expression is associated with those cases in which a patient is subject to more or less cough during the winter season, being free, or almost free, during the warmer portion of the year. It may come on at any period in the course of the winter, and is generally referable to some obvious cause, which produces 'a cold.' The attacks tend as a rule to become more aggravated and difficult to cure, as well as more easily excited, as time progresses. There is no valid reason why cases of winter-cough should receive any special designation. At any rate, this should not prevent them from receiving due attention, instead of being summarily dismissed as mere cases of 'winter-cough'; and it is important in every instance that satisfactory investigation should be carried out, so that the exact conditions which produce the cough may be determined, and the proper treatment pursued which these conditions indicate.

Without entering into details, it may be stated that cases of winter-cough belong chiefly to the following classes: 1. Not uncommonly it is merely due to a slight catarrh, affecting the throat and main air-passages. 2. Most frequently the cough depends on bronchial catarrh or bronchitis in various degrees, usually associated with more or less emphysema. 3. Winter-cough may characterise some chronic phthisical cases, this symptom subsiding during the warmer season. 4. There are certain forms of cardiac disease, of which winter-cough may be a prominent phenomenon.

Treatment.—The treatment of winter-cough must depend on the nature of the cause which gives rise to it, and will be found discussed in the special articles descriptive of the several conditions. *See* Cough.

Frederick T. Roberts.

WOMB, Diseases of.—Synon.: Fr. *Maladies de l'Utérus*; Ger. *Krankheiten der Gebärmutter*.

There is probably no department of practical medicine in which more progress has been made within the last twenty years than that comprehended under this article; and it was only after the invention of exact methods of physical examination, such as the speculum and the uterine sound, that its advance towards the prominent position it now holds commenced. Indeed, until these came into use the gynæcologist was much in the same position, with regard to diseases of the uterus, as the general physician with regard to diseases of the chest before Laennec's immortal discovery. In the one case, as in the other, the practitioner had of old to trust to general symptoms only, and these were very apt to mislead. As it is only by an accurate examination of the uterine organs that any certain knowledge of their condition can be acquired, the method of making such examination forms an essential preliminary to the study of uterine disease.

Methods of Physical Examination. 1. *Digital Examination.*—Of all methods of examining the uterine organs, the most important is by the finger alone, nor is the necessary *tactus eruditus* by any means easy to acquire. In this country the lateral position is generally adopted, and, except under special circumstances, is preferable, as involving less exposure than the dorsal. The patient should lie on her left side, with her hips as near the edge of the bed as possible. The semi-prone position is the most convenient, the patient lying more or less on her face, her knees being flexed, the upper one more so than the lower. A good position much facilitates a complete examination of the pelvic cavity, and attention to these details is never superfluous. The index finger of the right hand is now carefully introduced, at first in the axis of the vaginal outlet, and then in that of the pelvic brim. The unimpregnated uterus is suspended, as it were, at the top of the vaginal canal, with the cervix projecting into it. The latter is the part of the uterus which the finger first reaches. As the normal direction of the uterus corresponds with the axis of the upper part of the pelvis, or, roughly speaking, with a line extending from the umbilicus to the coccyx, the cervix, in a healthy state, projects into the vagina, and points backwards towards the sacrum. Its shape varies in women who have had children, and in the unmarried or nulliparous. In the latter it is conical or nipple-shaped, and the opening of the os uteri is felt at the apex of the cone, as a circular aperture about the size of a pea. The anterior and posterior boundaries of the os uteri are known as the lips of the cervix, and they are very liable to alterations in size, becoming congested or enlarged under various morbid states, one often to a greater extent than the other. In women who have borne children the shape of the cervix is altered, and it becomes shorter and less regularly conical. The os is also changed from a circular opening into a transverse fissure, which is often more or less nodular and irregular at its edges, from lacerations of its tissues during labour; and is sometimes sufficiently open to admit the tip of the finger. When healthy, the mucous membrane covering the cervix is smooth and velvety to the touch; and through the speculum it is seen to be of a uniform rose-pink colour. Under various morbid conditions it becomes rough, granular, stripped of its epithelium, and covered with hypertrophied papillæ, and these alterations are of much importance from a diagnostic point of view. Having ascertained the conditions of the cervix, paying particular attention to its size, shape, density, and sensibility, and to the shape of the os uteri, we may next proceed to examine the body of the uterus, passing the finger for this purpose past the cervix into the vaginal *cul-de-sac* behind, in front, and on either side of the uterus. In this way we feel whether the uterus is of normal size, or hypertrophied, as it often is; whether it is painful on pressure, or not; whether the uterus is freely movable by the finger, as it ought to be; or whether it is fixed and immovable in any part of its contour, as is often the case from inflammatory adhesion in its vicinity. Then again, in the same examination, we ascertain if any swelling exists in any part of the vaginal *cul-de-sac*, in front, behind, or at either side; and if so we try to determine its form, density, mobility, sensibility, and whether it is attached to the uterus, or is independent of it—all points of importance in arriving at an accurate diagnosis.

2. *Palpation.*—In this part of the examination we may often gain much assistance by combining *abdominal palpation* with vaginal examination. This method of bi-manual examination is always of great utility, and is sometimes indispensable for accurate diagnosis, and it is not so generally practised as it ought to be. It may be used to some extent while the patient is still lying on her side, the left hand being passed over her right hip. But to practise it thoroughly we must make the patient turn over on her back, and then by pressing down the abdominal parietes with the left hand, and acting in concert with the examining finger, we may thoroughly explore the pelvic cavity, and ascertain much more completely the form and relations of any tumour within it, than by vaginal examination alone. In some cases valuable information can be obtained by a rectal examination, especially when there is a swelling or tumour in Douglas's pouch, or attached to the posterior part of the uterus, which may often be more accurately examined in this way than *per vaginam*. Simple abdominal palpation is often necessary in investigating the nature of any tumour supposed to be uterine. This is best carried out by laying the patient on her back, with her knees elevated, so as to relax the abdominal parietes. Percussion may often be advantageously combined with palpation. By using one or two fingers of the left hand as a pleximeter, and percussing with the right, we get a dull or tympanitic sound. If the latter is marked where there is much abdominal distension, we know that it indicates bowel distended with gas, and that there is probably no

tumour. If there be dulness we can limit its area, and thus verify the results of palpation by mapping out any abdominal swelling met with. By these means also we discover the existence of fluid, either free in the abdomen, as in ascites, or contained in an ovarian cyst, the presence of fluctuation being often very readily determined.

3. *Use of the Speculum.*—We now proceed to consider the means at our disposal for examining the lower segment of the uterus with the eye; and from the re-invention of the speculum by Recamier, in the early part of the present century, we may date the commencement of the accurate study of uterine diseases. Numerous varieties of specula have been used. One very generally employed is Cusco's bivalve speculum (fig. 177). This has the advantage of being easy to introduce, and of being adapted for either a capacious or a narrow vagina. It exposes the cervix well. The objections to it are its expense, and the fact that the metal is apt to be affected by various applications made to the cervix. Personally the writer prefers the tubular (Fergusson's) speculum (fig. 178), made of glass and covered with caoutchouc; and that which is bevelled at the end is the easiest to introduce, and the best to expose the cervix. For cleanliness and brilliancy of illumination nothing can equal it. It is unaffected by any remedy used for local application, and has the advantage, which is wanting in all other specula, of embracing and steadying the cervix. In certain cases requiring local medication this is of great value. The objection to this form of speculum is its fragility, and the necessity of having instruments of various sizes, adapted to vaginæ of different dimensions. Practitioners, therefore, at a distance from surgical-instrument makers, will do well to provide themselves with the more expensive instrument. Another form of speculum much used of late years, and in some cases superior to all others, is the 'duck-bill' speculum (fig. 179). This acts on the principle of drawing aside the perinæum and posterior vaginal wall, so as to allow air to distend the canal, and thus expose the cervix. For certain operations it is invaluable, and is most valuable even in ordinary examinations if the practitioner be skilled in its use. Considerable practice is required, however, to employ it satisfactorily, and it has the further drawback of necessitating the assistance of a second person.

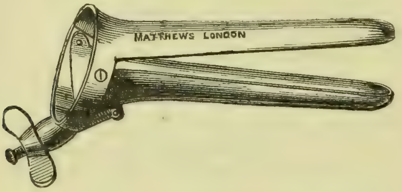

Fig. 177.—Cusco's bivalve speculum.

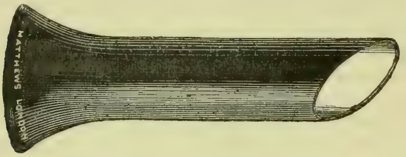

Fig. 178.—Fergusson's speculum.

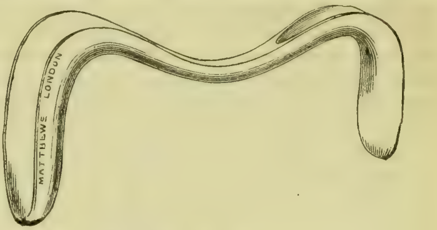

Fig. 179.—The Duck-bill speculum.

The passing of a speculum, without pain, is an operation requiring some little practice to perform skilfully. In using a tubular glass speculum we must first choose one corresponding to the size of the vagina. This is a point of some importance; for the attempt to pass a large speculum into a small vagina causes much suffering; and if, on the other hand, too small an instrument be used, the cervix is not properly exposed. The patient should lie in the ordinary lateral position. The speculum should then be taken in the hollow of the right hand, its bevelled extremity resting on the under-surface of the index finger, the point of which should project a little over its edge, so as to guide it through the ostium vaginæ. The point of the finger having been inserted into the vagina, the mouth of the speculum, the centre of which is grasped gently by the other fingers of the right hand, is held by the left hand, and the instrument, guided along the under-surface of the right index finger, is gently insinuated into the vagina, pressing back the perinæum as it enters. When it is fully introduced, it is turned gently round until the cervix is well exposed.

By the speculum we can speedily recognise any changes in the cervix and os uteri; we can see if the mucous membrane covering the former be pale or congested, smooth or abraded, or perhaps covered with granulations which bleed on being touched. The character and amount of discharge should be noted, and it may be wiped away with cotton wool held in the speculum forceps. If the discharge come in great measure from the interior of the cervix and body of the womb, it is glairy, transparent, and very tenacious, and it may often be seen oozing out of the os uteri like white of egg. This is a certain sign of some morbid state of the mucous lining of the uterus. If the discharge come from the surface of the cervix, it is yellow and purulent in appearance. We can also recognise any abnormal growth that exists about the cervix, as, for instance, small gelatinous polypi which have evaded the sense of touch.

4. *Examination with the Sound.* — In certain cases in which more accurate information regarding the state of the uterus is required, other accessory means of examination are used. One of these is the uterine sound (fig. 180), by means of which we can explore the interior of the uterus, measure its length, ascertain its direction, &c. The instrument is a thin rod of flexible metal, which can be bent into any desired shape, as it is sometimes necessary to adapt it to the altered curve of the uterine cavity. Its length is divided into inches by means of small notches in the metal, and at two and a-half inches from its point is a small knob, indicating the normal length of the healthy uterus. In introducing the sound, the index finger of the right hand is passed into the vagina until its tip rests on the opening of the os uteri, which can be felt as a dimple or depression at the extremity of the cervix. The handle of the sound being lightly held in the left hand, its point, previously warmed and oiled, is guided along the palmar surface of the index finger of the right hand, until it enters the os uteri. It is a good plan to pass the sound through the vagina with its concavity looking towards the perinæum, and after it has entered the os, to turn it gently round, so that its further progress may be in the ordinary direction of the uterine cavity. It is now gently pushed on, no force whatever being used, until its point is arrested by the fundus uteri. The tip of the right index finger is now placed at the os, and withdrawn in contact with the sound, so that the exact length to which it has entered may be ascertained. Considerable practice is required to pass the sound easily and without pain. Gentleness is necessary above all, and the sound should be coaxed to pass, being withdrawn if any resistance is met with, and never pushed on by force. Sometimes the sound will not pass in the ordinary direction, and then an endeavour must be made to adapt it to the curve of the uterine cavity, by bending it, or by passing it with its concavity backwards, as in the cases of retroflexion. The kind of information to be derived from the use of the sound will be best appreciated when treating of the separate diseases of the uterus.

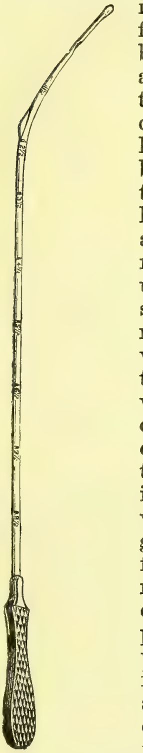

FIG. 180.—The Uterine Sound.

5. *Dilatation of the Cervix.* — Another mode of examination, sometimes of much use, is the dilatation of the cervix by sponge or laminaria tents, or by Hegar's dilators, so as to admit of the introduction of a finger, and complete exploration of the uterine cavity. This is of immense service in cases of profuse menorrhagia, when the existence of an intra-uterine polypus, or portion of retained placenta, is suspected. The tent is a mass of compressed sponge, or a cylinder of laminaria digitata, sufficiently small to enter the cervix, where it swells by the imbibition of moisture, and in doing so expands the surrounding tissues. A good way of effecting the desired object is by passing side by side into the cervix a bundle of laminaria bougies, sufficiently long to reach the fundus. These, if left *in situ* for twenty-four hours, dilate not only the cervix but the whole uterine cavity, and admit of its being thoroughly explored under an anæsthetic. In order to effect this easily, the cervix should be exposed by a duck-bill speculum. Hegar's dilators are a series of graduated uterine bougies, made of vulcanite, one of which is inserted into the uterus for about two minutes, beginning with No. 1, and gradually progressing to No. 23 or 24. By this means comparatively rapid and very effective dilatation can be produced. Careful antiseptic precautions are essential, and the operation must be performed under an anæsthetic. In the hands of an expert this is probably the best method at our disposal. Dilatation of the cervix is an operation that should not be undertaken without due consideration, as it is occasionally followed by considerable irritation.

General Ætiology and Pathology of Uterine Disease.—Much as is the attention which has been paid to uterine disease of late years, the opinions of the profession are as yet far from being decided on many elementary facts connected with it. It is beyond doubt that in this class of disease there are a series of symptoms common to all cases alike, such as pain in the lower part of the abdomen and back, inability to walk, leucorrhœal discharge, and disordered menstruation. If, however, modern writers on gynæcology are consulted, it will be at once seen how various and irreconcilable are the explanations given of these symptoms. Thus we have a school who teach that in inflammation and congestion, either of the cervix alone, or of the body or lining membrane of the uterus, we have the key to uterine pathology, and that all other changes detected in the uterus, such as displacements or flexions, are merely secondary results of the primary affection. On the other hand, there are many influential gynæcologists who refer all uterine disease to mechanical causes; who consider displacements to be the primary cause of nearly every morbid state of the uterus, inflammation and congestion being merely secondary results; and who naturally limit their treatment to an endeavour to replace and support the uterus in its normal position. The want of sufficient pathological study of morbid states of the uterus accounts for these varying opinions, which are much to be regretted; for, while one set of theorists apply themselves to an endeavour to relieve the inflammatory symptoms they find, and which undoubtedly generally exist, by leeches, rest, and suitable local applications, they are apt to undervalue and neglect the mechanical means by which the displaced organ may be supported and steadied, on which their opponents too exclusively rely, but the real value of which it is impossible to call in question. Hence it follows that these partial and one-sided views lead to neglect of really important measures in one direction or the other, and to an amount of uncertainty in the mind of the profession which materially impedes a due recognition of the true importance of uterine disease. The fact, no doubt, is that neither of these opposing views is entirely right, but that there is a large measure of truth in both. Of the importance of inflammatory conditions no one, who impartially studies the clinical history of cases coming under his care, can entertain any reasonable doubt. The large, tender, and congested uterus, with its thickened and hypertrophied walls, the inflamed and granular mucous membrane covering the cervix, and pouring out abundance of morbid secretion, are conditions too obvious to be overlooked, and which are very frequently indeed associated with displacements, resulting from alterations in portions of the hypertrophied and overweighted organ. In some of these cases treatment directed to the original inflammatory condition may, of itself, suffice to effect a cure; in others this fails, unless attention be at the same time paid to the secondary displacements. On the other hand, it is equally impossible to ignore the occasional remarkable influence of a simple displacement in producing disease. Who, for example, that has witnessed the long chain of distressing symptoms following a traumatic displacement, such as retroflexion from a fall, and the instantaneous relief sometimes following the introduction of a suitable pessary, can doubt this? In fact, all these conditions act and re-act on each other, and too excessive attention to one set of symptoms, based on theoretical dogmas, is as fallacious in uterine as in all other forms of disease.

The causes of uterine disease are very numerous. Among the most common may be mentioned errors in the mode of life consequent on the habits of modern society, such as tight-lacing, want of proper exercise, heated rooms, imprudence during menstruation, and the like. By far the most prolific source of uterine disease is to be found in the changes in the uterus consequent on parturition. Many accidental circumstances are apt to check and arrest the involution of the hypertrophied muscles, which normally occurs after delivery. Hence the uterus remains large, congested, heavy, tender, and in the condition known as sub-involution, its cavity, as measured by the uterine sound, being elongated. In such cases the symptoms of uterine disease creep on insidiously after abortion or child-bearing, and, in a large proportion of cases, it will be possible to trace its origin to this source.

In considering the diseases of the uterus, it will economise space if we divide them into four classes, namely: (1) Inflammatory and Congestive Diseases, with their results; (2) Displacements; (3) Malignant Diseases; and (4) Tumours.

1. Inflammatory and Congestive Diseases. — Under this heading we may consider together those morbid states of the uterus which are variously described under such terms as *acute* and *chronic metritis*, *chronic parenchymatous metritis*, *areolar hyperplasia*, *acute* and *chronic endometritis*, *endo-cervicitis*, *chronic uterine catarrh*, *granular degeneration of the cervix*, *ulceration of the cervix*, *congestion of the uterus*, and others.

This course involves the disadvantage of describing together diseases which, whilst they are very generally associated, and have much that is common in their symptomatology and treatment, may often, on the other hand, occur separately, and require important modifications in their management, according to the particular parts of the uterus affected. It is impossible, however, in so short an article, to discuss their individual peculiarities, as would naturally be done in a systematic treatise.

Acute inflammatory affections of the uterus, whether of its body or of its lining membrane, are of comparatively rare occurrence when unconnected with the puerperal state; and if a contrary opinion is expressed in many of our gynæcological works, it is probably because various other inflammatory diseases, especially localised inflammations of the peritoneum and cellular tissue near the uterus, have been confounded with inflammations of the uterus itself. No practical harm will result, therefore, if we limit ourselves to the consideration of the more *chronic* conditions which are of such common occurrence, and produce such important consequences. One of the most common is undoubtedly congestion of the uterus, associated with enlargement of its vessels, and very often leading secondarily to more important and lasting disease, such as inflammation of its lining membrane, and the condition described as *areolar hyperplasia* or *chronic parenchymatous metritis.*

Ætiology and Anatomical Characters. The causes of such congestions are very numerous, and indeed they occur normally in connexion with every menstrual period, and may readily be perpetuated. By far the most important, however, is some interference with the proper involution of the uterus after delivery or abortion, to which a large proportion of such disease may be traced. If such congestion continue to be repeated, whatever be its cause, it very often leads to inflammation of the mucous membrane lining the cervix or body of the uterus; and then the diseases known as *endo-metritis* or *endo-cervicitis* are established, which are of much importance. In these the largely developed glandular structures of the mucous membrane are the parts chiefly involved. On microscopical examination they are found altered in character, dilated at their mouths, and pouring out abundantly the transparent spongy mucus which is so characteristic of these affections. The villi of the cervix, both those within the canal and on its exterior, become altered, stripped of their epithelium, and eventually hypertrophied. These enlarged and abraded papillæ on the surface of the cervix, when seen through the speculum, form the characteristic red, strawberry-like abrasions round the os, which, under the name of ulceration, have formed so fruitful a subject of controversy in uterine disease. The detection of this condition—which is in no sense of the word an ulceration, since the epithelium is the only structure destroyed—is of much importance from a diagnostic point of view, but chiefly as leading to a knowledge of the more deep-seated changes which have produced it as a secondary result, which are themselves beyond the sphere of observation, but which are truly at the root of the evil. Hence the granular and abraded state of the cervix must be looked upon as a mere indication of disease elsewhere, not as being in itself a primary disease. Moreover, it is to be noted, as specially pointed out of late by American gynæcologists, that many apparent abrasions of the cervix are really due to laceration of its tissue, and eversion of its altered lining membrane, a condition which can only be satisfactorily made out when the duck-bill speculum is used.

In more advanced stages of these inflammations of the mucous membrane deeper-seated alterations occur. The glands become obliterated or atrophied, and sometimes undergo cystic degeneration; and the whole mucous membrane may become adherent, stripped of its epithelium, covered with granulations, or finally converted into a layer of connective tissue covered with polymorphous cells (Klebs). In no long time, moreover, other morbid states of the uterus are developed. The organ becomes enlarged and tender to touch, and very often there is more or less forward or backward displacement. The cervix especially is apt to be hypertrophied, the os patulous, much leucorrhœal discharge is present, and all the distressing chain of symptoms accompanying confirmed uterine disease is established. Pathologically, this enlarged and tender state of the body and cervix of the uterus is, by most recent writers, believed to depend on excessive growth of the connective tissue, associated with vascular hyperæmia and hyperæsthesia of the nerves. It should be remembered, however, that it is identical with the condition commonly described as *chronic metritis*, the essentially inflammatory origin of which has long been an axiom in gynæcology.

Symptoms.—The symptoms accompanying these morbid states of the uterus are, in a great measure, those which are common to a large number of uterine complaints. Pain in the lower part of the abdomen and back, increased by exercise of any kind; pain in defæcation or micturition, and, in married women, on sexual intercourse; profuse glairy, tenacious, or purulent discharge, in old-standing cases very abundant; disordered menstruation, either scanty or irregular, or more often profuse, and frequently very painful; and eventually, if the true character of the disease be not recognised, a long and distressing catalogue of general symptoms, such as dyspepsia, hysteria, sickness or vomiting, headache, and others too protean in their character to be described, are among those which are most commonly observed.

The conditions met with on physical examination vary with the duration and extent of the disease, and the tissues of the uterus chiefly implicated. In the simpler cases the uterus is merely somewhat heavy and enlarged, and tender to the touch. When there is endo-metritis or endo-cervicitis to any extent, the cervix is somewhat puffy and enlarged, and the external os patulous, so that the sound passes easily; and, in the same way, a dilated state of the cervical canal and internal os is recognised. Very generally also the surface of the cervix is rough, granular, and greatly abraded, bleeding on being touched, while strings of the characteristic gelatinous discharge are seen to exude from the cervix, and the cervix may be extensively fissured. Lastly, on bimanual examination, in the more chronic and confirmed cases, the whole uterus will be found to be distinctly enlarged, probably somewhat elongated when measured by the sound, and very commonly the subject of some of the forms of displacement to be presently described.

Prognosis.—The prognosis of these diseases must, of course, depend on their extent and duration. In their earlier stages they are readily susceptible of improvement and cure. In old-standing cases, which have lasted for years, and produced all the local and general results above described, the treatment is surrounded with difficulties, and the prospect is far from encouraging. It is of such states that Scanzoni speaks when he says, 'We do not remember a single case in which we have cured an abundant uterine leucorrhœa of several years' standing'—a dictum which was doubtless true with reference to the methods of treatment generally employed, but which fortunately cannot be endorsed by those who have employed more radical means of cure, applied directly to the seat of the disease.

TREATMENT.—The treatment resolves itself into *general* and *local*. With regard to the former, the indications are to do all in our power to improve the nutrition and general health by ordinary means of treatment, such as attention to diet, fresh air, and the administration of appropriate remedies, of which such drugs as quinine, small doses of arsenic or strychnine, various ferruginous preparations, and bromide of potassium, either alone or in combination with other remedies, especially when there is much nervous irritability, are amongst the most generally useful. In old-standing cases resort to some of the Continental watering-places is occasionally of much service. These points, however, all depend on general principles, and cannot be further dwelt upon. Among the local measures one of the first and most important to attend to is *rest*. If moving about produce pain, repose in the recumbent attitude ought certainly to be enforced, and in recent and acute cases it should be absolute. In chronic cases continuous rest leads to the evils of deterioration of the general health, and the risk of acquiring habits of chronic invalidism. This must, then, be decided by the exigencies of the particular case, and the judgment of the practitioner. Generally, some daily gentle exercise, short of fatigue, should be advised, such as walking a little distance, driving in an easy carriage or bath-chair, or sitting in the open air. We may safely assume that exercise which does not produce or increase pain is doing good.

In cases of simple hyperæmia, especially when not of old standing, and when the uterus is tender to the touch, the local abstraction of blood is often of marked benefit. This may be effected either by applying from two to four leeches to the cervix through a cylindrical glass speculum, or, still better, by puncturing the cervix with a scarificator made for the purpose. Another very effectual means of relieving congestion and tenderness of the uterus is the use of pledgets of cotton wool, to which a string is attached, thoroughly soaked in glycerine. If one of these is introduced into the vagina at night, and removed by means of the string in the morning, it will be found to produce an abundant watery discharge which saturates the linen of the patient. Great relief is thus given, and there is hardly any form of congestive uterine disease which is not benefited by this treatment, which most women can apply for themselves. The glycerine pledgets may be used every night, and they do not interfere with other modes of treatment. Continuous irrigations of hot water at 110°, night and morning, are also most serviceable, but to be of use not less than from one to two gallons must be used, with a suitable cistern syringe. When properly applied these give immense relief. When the uterus is enlarged as well as tender, much benefit may be derived from the application of a pledget of iodised cotton to the cervix once a week. This should be passed through the speculum, and retained in position by a large pledget soaked in glycerine. It rarely causes pain; if it do, it should be at once removed; and it often remarkably reduces the size of the subinvoluted and hypertrophied womb.

When there is evidence of endo-metritis or endo-cervicitis other treatment is required. Now the desideratum is the application of alterative remedies to the diseased mucous membrane, not with the view of destroying it, but of so modifying its circulation and nutrition as to set up healthy action. The want of success so common in treating these cases may be traced to the fact that remedies have not been applied directly to the interior of the cervix or uterus, but that practitioners have contented themselves with treating the abraded or granular condition of the cervix, thus leaving the real seat of the disease untouched. Of late years much advance has been made, and we need not now talk of these chronic inflammatory affections of the lining membrane of the uterus in the same hopeless strain as before. One of the earliest modes of intra-uterine medication was the injection of fluids into the uterine cavity, such as tincture of iodine, or solutions of nitrate of silver. It was soon found that such injections, when the cervix had not been previously dilated, were apt to be followed by very alarming and dangerous symptoms; and it is now generally admitted that they are inadmissible, unless the cervix has been previously dilated with sponge or laminaria tents. This in itself is a procedure not to be lightly undertaken; and to repeat it frequently for a length of time—as would be essential in the treatment of these chronic cases—would be altogether out of the question. Some other method of attaining the desired object is therefore necessary, and this we obtain in perfection in the local application of the desired alteratives on suitable probes covered with a thin layer of cotton wool. By this means we can reach

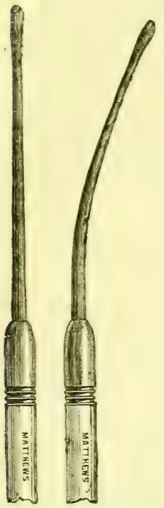

FIG. 181.—Uterine Probes.

the mucous membrane at any part of the uterine cavity, and apply our remedies to it, without the necessity of any preliminary dilatation. The probes used by the writer are made of flexible metal (fig. 181), attached to a wooden handle, and of such a size that, when tightly wrapped round with a thin film of wool, they are not thicker than an ordinary uterine sound. They are covered by teasing out a small portion of wool, which is flattened between the palms of the hands. The probe is then dipped in water, to cause the wool to adhere, and by twisting round the handle, the wool being held between the forefinger and thumb of the left hand, the wool is smoothly and firmly wrapped round it. A little practice enables us to effect this with great neatness. The cervix being generally abnormally patulous, there is no difficulty in passing the probes through the os, previously exposed by the speculum, so as to reach the entire uterine cavity. The writer is in the habit of using a mixture of equal parts of crystallised carbolic acid and glycerine, as a local alterative, than which, he believes, there is no better application. Others, however, employ tincture of iodine, or strong solutions of nitrate of silver; or they even, as recommended by Courty of Montpellier, pass a solid piece of nitrate of silver into the uterine cavity, leaving it there to melt and flow over the mucous membrane. The writer first swabs out the uterine cavity with one or two probes covered with dry wool, so as to remove the glutinous discharge as much as possible, and then passes in another probe, covered with the carbolic solution, so as to paint over the lining membrane of the cervix and body of the uterus, the external abrasions on the cervix being subsequently swabbed over with the same solution. This rarely gives rise to any pain or discomfort, and may be combined with the other plans of treatment already mentioned. Intra-uterine medication is most useful in the week immediately succeeding menstruation, when the superficial layer of the mucous membrane has been shed. If used too near the advent of the next period it may prove too irritating, and may bring on menstruation prematurely. As a rule, two applications, at intervals of a few days, in the early part of the intra-menstrual interval are amply sufficient, and it may be necessary to continue the treatment for many weeks or months. The writer of late has found the application of the continuous electrical current, through a carefully insulated sound, a still more efficient and much more rapidly effectual method of intra-uterine medication. Some three or four applications of about 100 milliampères will often effectually cure an intra-uterine leucorrhœa of long persistence. Unfortunately this is a method of treatment that is not generally applicable, since it requires an expensive plant, and very considerable practical experience, in order that it may be safely and efficiently used. Should laceration of the cervix and ectropion exist, Emmett's operation of trachelorrhaphy may be indicated. In very severe and obstinate cases of this kind Recamier used to scrape the uterine mucous membrane with a curette, so as to remove the granulations, especially when there was much metrorrhagia, and where there was reason to suspect the existence of a granular condition of the intra-uterine mucous membrane. The Dublin physicians recommend the application of fuming nitric acid, the cervix having been first dilated with tents. This is a very strong measure, which we would not willingly adopt; but it is only fair to say that in the cases in which the writer has used it he has found it exceedingly useful. Scraping the uterine cavity with the dull wire curette also occasionally has an admirable result in such conditions; and, so far as the writer's experience goes, this is a perfectly safe procedure. Before concluding this subject, a word of caution is necessary. Valuable as intra-uterine medication certainly is in suitable cases, it should never be rashly or indiscriminately employed, and the writer would strongly insist that, before resorting to it, we should satisfy ourselves that the uterus is likely to bear it with impunity. Whenever, therefore, there is much tenderness of the womb on being touched, even when the case is otherwise suitable, the writer deems it advisable first to remove the congested condition by rest, the local abstraction of blood, the use of glycerine pledgets, hot-water irrigations, and other appropriate means; and, above all, the slightest evidence of any concomitant mischief or irritation, recent or of old standing, in the neighbourhood of the uterus, as shown by tenderness on pressure in the region of the broad ligaments, or fixity of the uterus, should be an absolute contra-indication.

2. **Displacements.**—Under this head we have to discuss a variety of diseases which have furnished a fruitful theme for controversy among gynæcologists. Practically, physicians have divided themselves into two great schools with regard to these affections. One of these schools teaches that deviations of the uterus, in whatever direction they occur, whether forwards, backwards, or to either side (for descent of the uterus is of a different character, and must be separately

discussed), form of themselves serious maladies accompanied by definite symptoms; and, as a logical deduction, that their treatment should primarily consist in the endeavour to replace the dislocated uterus in its normal position, and maintain its position by mechanical contrivances known as *pessaries.* The other, and much larger, school holds that versions or flexions are not *per se* the cause of the undoubted symptoms which are met with in the cases in which they are found to be present; that flexions may, and often do, exist without giving rise to any symptoms at all; that in all cases the symptoms may be traced to the uterine engorgements and congestions which accompany the deviations, and are their primary cause; and that, therefore, it is unnecessary to pay attention to the displacement, which may be left to itself, while associated conditions are remedied by appropriate treatment. As is generally the case in all such controversies, it is probable that neither side is entirely in the right, and that the truth is to be found between the two. It is certain that in some cases, and under certain peculiarities of constitution, flexions produce symptoms which cannot be explained by the accompanying condition of the uterine structures, which can only be relieved by mechanically supporting the dislocated womb, and frequently are so relieved in the most remarkable manner. It is unquestionable, however, that marked flexions often exist without producing any appreciable symptoms, and as these are only found out accidentally, when, from some other cause, an examination is made, it is not improbable that such cases are much more common than is generally supposed. Upon the whole, the writer is inclined to think that displacements are rather the result than the cause of the associated morbid state of the uterus, and that one of the chief elements of treatment is to get rid of the congested, hypertrophied, or sub-involuted state of the organ which produces them. But, even if this be admitted, it by no means follows that proper mechanical support is not needed. So far from this being the case, the writer believes it to be of the greatest possible value in supporting and steadying the overweighted and misplaced organ, thereby facilitating the removal of its morbid states, as well as relieving its most urgent symptoms.

Properly speaking, displacements of the uterus should be divided into two classes, *versions* and *flexions.* In the former the body of the uterus retains its normal shape, but not its normal direction, the entire organ being displaced either forwards (*ante-version*), backwards (*retro-version*), or to one side (*latero-version*). In the latter the shape of the uterus is altered, and its body is more or less acutely bent over the cervix in the form of a retort, producing the analogous conditions of *ante-flexion, retro-flexion,* or *latero-flexion.* But these states are very closely related to each other. Very often they are combined, they arise from similar causes, and they produce similar results. For the sake of brevity, therefore, they will be discussed together.

Ætiology and Pathology.—In order to understand how uterine displacements are produced, it is necessary to remember the means by which the uterus is maintained in its natural position. In the healthy state the uterus is situated high in the pelvic cavity, its fundus projecting somewhat above the plane of the pelvic brim, to the axis of which—that is, to a line drawn from the umbilicus to the coccyx—its own axis corresponds. It is maintained in this position partly by the muscular column of the vagina below, on which it is, as it were, poised; partly by the folds of the peritoneum forming Douglas's pouch behind, especially that portion of them called the utero-sacral ligaments; and partly by fibrous portions of pelvic fascia in front, attached to the pubes and passing by the side of the bladder. These are fixed to the uterus above the points of junction of the internal os with its body, which is, therefore, the part of the organ least liable to change of position, and that at which flexions almost invariably take place. The fundus and body are much more mobile, but their movements are somewhat controlled by the round ligaments in front, and the broad ligaments at the side. The shape of the uterus is further maintained by the well-marked inherent rigidity of its tissue, and when this is altered by disease, as by congestion, sub-involution, and the like, displacements are much more apt to occur. The axis of the uterus is naturally apt to alter its position under various conditions. Thus it falls less or more forwards, according as the bladder is distended or otherwise. The uterus is also so placed that it ascends or descends with more or less freedom, and, as it does so, its axis corresponds with the axis of the plane of that part of the pelvis in which it lies. This fact has been especially pointed out by the late Dr. Squarey, and it goes far to explain why similar causes should at one period produce a forward, and at another a backward, displacement. The causes of displacements are chiefly any conditions which weaken the supports, or the resisting power, of the uterus. They are, therefore, most frequently found in association with the results of parturition—sub-involution, congestion, hyperplasia, and endometritis—which all diminish the inherent tonicity of the uterine walls, as well as weaken its supports, and prevent its regaining its natural shape when accidentally altered. The displacement itself may be caused or favoured by a variety of conditions, such as blows, falls, tight clothing, fibroid tumours developed in the uterine walls, and many other analogous states. When a flexion has been produced, the venous capillaries at the point of flexion are more or less obstructed, and the return of blood through them hindered, while the arteries continue to supply blood. The fundus, therefore, becomes congested, and subsequent structural alterations are developed. This point has been insisted on by the late Dr. Graily Hewitt, and there can be no doubt of its accuracy. This explains the fact that, even when flexions are secondary, it is impossible to treat them satisfactorily by general means alone, and that, in course of time, a flexion, originally secondary in its causation, may require to be the chief object of treatment.

SYMPTOMS.—The symptoms of flexion of the uterus are in no way special. They are very much those which have already been described as accompanying the inflammatory varieties of uterine disease, and there are none which would enable the practitioner to foretell its existence with certainty. Amongst those most commonly observed are pain, weight, and bearing down, often decidedly increased by exercise of any kind, not infrequently rendering locomotion an impossibility; pain in one or other ovarian region; pain, and sometimes difficulty, in micturition; and various disorders of the menstrual function, more especially dysmenorrhœa and menorrhagia. After these have lasted some time the secondary derangements of the general health, so common in uterine disease, become established, and they lead to very serious consequences.

DIAGNOSIS.—The diagnosis of displacements is not difficult on vaginal examination. Supposing we have to do with a flexion, the cervix is found in its normal position; but either in front, behind, or, more rarely, at either side, is a rounded swelling about the size of half an orange, which can be pushed away by the examining finger. This might be confounded with various other conditions, such as small uterine fibroids, inflammatory exudation, hæmatocele, and small ovarian tumours. The diagnosis can, however, be readily cleared up by the sound, which will only pass in the direction in which the uterus is flexed; and, when it is turned gently and cautiously round, the flexed fundus is lifted with it, and can no longer be felt in its former position. In ante- or retro-version, in addition to feeling the body of the uterus in its abnormal situation, we also find that the cervix is lifted out of its usual central position, and points either forwards or backwards respectively.

TREATMENT.—In arranging a plan of treatment for uterine displacements, the concomitant conditions should be carefully attended to, and endometritis, congestion, and other complications relieved, if they exist. Unless this be done, the treatment may entirely fail, or may be very unnecessarily prolonged. Here we must limit ourselves to a very brief description of the best plans of mechanical treatment, strongly insisting, however, that they should not be too exclusively relied on. In backward displacements we have a very satisfactory means of supporting the misplaced organ in the well-known Hodge's pessary, numerous modifications of which exist. The important point to bear in mind is to select an instrument not too bulky, nor too long, for the individual case; the best material being either wire covered with soft indiarubber, vulcanite, or Britannia-metal. The treatment often fails from want of proper selection; since a pessary, to be thoroughly useful, should be fitted as accurately as a shoe to a foot. Before introducing it, the sound should be gently passed, and the uterus replaced and held in its proper direction for a few minutes; and this manœuvre should be repeated from time to time, until the uterus does not re-assume its abnormal position. Even then, however, the pessary should be worn continuously for several months, until we feel quite sure that the misplacement is permanently relieved. In many cases relief is instantaneous and remarkable; in others the fundus is too tender to bear the pressure of the pessary at all. When this is the case it should be removed, and an endeavour should be made to prepare the uterus for the use of this support by the local abstraction of blood, hot irrigations, the application of glycerine pledgets, or sedative pessaries. In introducing the Hodge's pessary, care should be taken to guide its upper part into its proper position behind the cervix, so as to press up the fundus; and, as the case improves, a larger instrument should be introduced, so as to follow up the retreating fundus. Re-position of the uterus must, of course, never be attempted if there is reason to think that the fundus is bound down by adhesions, or if the uterus is very tender. In suitable cases, however, it materially facilitates the cure.

Anterior displacements must be treated on the same principles. Unfortunately, we do not possess anything like an equally good means of mechanical support, and a thoroughly efficient ante-flexion pessary is still a desideratum. After trying a good many, the writer has come to the conclusion that the best is the late Dr. Graily Hewitt's vulcanite cradle pessary, of a size suitable to the case. It is, however, difficult to introduce and remove. Nor can it always be borne. A well-fitting abdominal belt—and the best is that known as the American belt—is often of great assistance, by removing the weight of the superincumbent intestines. When all other means of restoring a flexed uterus fail, an intra-uterine stem pessary may possibly succeed. Great caution, however, is necessary, and it should never be used unless the patient is under constant supervision, so that it may be removed on the slightest appearance of undue irritation. During the treatment of all flexions, rest is of paramount importance—not absolute, but as much as possible; and exercise should be very sparingly permitted, and only in a tentative manner. In this (and the same remark applies to every other form of uterine disease), care should be taken that local examinations should be as infrequent as the necessities of the case will allow. In all such cases there is a distinct danger that ill-judged and unnecessarily frequent local treatments may end in producing neurotic complications which may prove to be worse than the disease they profess to cure.

Prolapsus.—The only other displacement of the uterus requiring special mention is descent or *prolapsus*, for the corresponding condition of undue elevation is of little practical importance. Descent of the uterus is far from rare, and it sometimes causes much discomfort. In it the uterus descends from its normal position to a varying extent, so that the prolapsus may be only partial, or it may be complete. When the entire uterus lies without the vulva, along with the everted vagina, the mass is known as *procidentia uteri.*

Ætiology and Pathology.—Descent of the uterus depends upon a variety of causes which lead to a weakening of the uterine supports, either from above or below. These supports are chiefly, above, the various uterine ligaments, with the cellular tissue of the pelvis; below, the muscular column of the vagina. When from any cause, such as imperfect recovery after childbirth, senile absorption of adipose tissue, or rupture of the perinæum tending to prolapse of the vagina, they are no longer able to support the uterus efficiently, a comparatively slight cause may suffice to allow the womb to be pushed or drawn out of its place, as, for example, straining, lifting heavy weights, undue weight of the organ itself, and many other causes. As soon as the organ is prolapsed, to whatever degree this may occur, various morbid alterations are pretty sure to follow. The uterus becomes irritated, congested, and hypertrophied; and the everted mucous membrane of the vagina, which then covers it, becomes greatly altered, and assumes almost the appearance of skin. The most characteristic change, however, is generally elongation of the cervix, through traction from below, especially in cases in which prolapse follows previous descent of the vaginal walls. This elongation is due to yielding of the elastic tissue of the cervix, especially that portion above the roof of the vagina, which becomes greatly elongated, so that the sound introduced into the procident organ may pass for six or seven inches. When the uterus is replaced, the normal elasticity again comes into play, and the cervix rapidly contracts. This is the condition described by Hugier as *hypertrophic elongation of the cervix,* and it is rarely absent.

Symptoms and Diagnosis.—The symptoms of prolapse of the womb are mainly due to the mechanical discomfort attending it, such as weight, difficulty in progression, interference with micturition, and much general inconvenience. The diagnosis is a matter of no difficulty. In the greater degrees the procident organ, covered with the hardened and altered vaginal mucous membrane, is at once apparent. The only condition it is at all likely to be confounded with is old-standing inversion of the uterus, and from this mistake the presence of the os uteri at the apex of the tumour will at once guard us. In the slighter degrees the cervix will be felt low in the vagina, or even at its orifice.

Treatment. — The treatment comprises two principal indications: First, rest, and consequent reduction of the size and weight of the procident organ; thereby greatly facilitating the second indication, namely, re-position, and maintenance of the uterus in its normal position. The effect of mere rest in diminishing the size of a prolapsed uterus is often very remarkable. A week or ten days in bed will often, of itself, reduce the cervical elongation to a considerable amount. Re-position is generally easily effected, and the chief difficulty is in support. In devising mechanical contrivances for keeping the uterus in position, the chief thing to bear in mind is that we should strengthen the natural uterine supports, so that they may regain their lost power of keeping the organ in its place. Hence the old ring or ball pessaries, which greatly distend the vagina, are absolutely inadmissible. In the slighter degrees an ordinary Hodge's pessary may answer every purpose, an endeavour being, at the same time, made to give better support from below. This is generally best done by a perineal pad, and also sometimes by using an astringent to the vagina, so as to make it a more efficient column of support, such as alum or oak-bark injections. In the greater degrees the best kind of pessary is that known as the 'vaginal stem,' which is in the shape of the cup of the ordinary toy known as the cup-and-ball, on the extremity of which the cervix rests, the other end being attached to a perineal band. If this does not answer, the pessary known as Zwancke's may succeed. This has the advantage of supporting the uterus without unduly distending the vagina. These measures are merely palliative, and a more radical cure may be hoped for by various operative procedures, into the details of which it is impossible to enter. It may suffice to say that they consist of: First, the removal of a small portion of the elongated cervix, either by the galvano-caustic wire or by the écraseur, in the hope of stimulating the remainder to contract, a procedure only occasionally required, but sometimes of undoubted utility. Secondly, the making of a new perinæum, in cases in which the prolapse seems secondary to undue descent of the vagina—a very valuable resource. Thirdly, narrowing of the vagina itself, for which a variety of operations are practised, which, like removal of a portion of the cervix, are rarely required.

3. **Malignant Disease.** — Malignant diseases are of common occurrence in the generative organs of females, and indeed they are more often met with in these than in any other part of the body.

Ætiology. — Malignant disease of the uterus is most common about the middle period of life, the largest number of cases occurring between forty and fifty years of age. Occasionally we meet with it in old women who have long ceased to menstruate, or with rapidly advancing cases in younger women under thirty years of age. Hereditary predisposition apparently plays some part in its production, but not so much as was formerly believed. Frequent child-bearing has a decided influence in favouring its development, since the proportion of cases is larger in multiparæ. To this may be added any causes of constitutional debility, since malignant disease unquestionably occurs more often in weak and unhealthy, than in strong and robust women.

Anatomical Characters.—All the recognised forms of malignant disease occur in the uterus, but some of them are more common than others. Scirrhus is that which is least frequently observed, and medullary carcinoma most often. Klebs, however, has pointed out that in the earliest stages of carcinomatous disease the fibrous element preponderates in the affected part; while, as the malady progresses, cell-growth rapidly advances, so that in old-standing cases, and at *post-mortem* examinations, the medullary carcinoma is that which is found, although, at first, the scirrhous form may probably have existed. Another common variety of malignant disease is the epithelial cancer, which chiefly affects the mucous membrane of the cervix. The so-called colloid cancer is rarely met with. In the large majority of cases the cervix is the part first affected, although, in exceptional instances, the disease may originate in the body of the uterus, the cervix being at first unimplicated.

At the commencement of the more ordinary variety the cervix is hard, somewhat nodular, and hypertrophied. It is comparatively rare for the disease to be seen at so early a stage, and, as the uterus is then quite movable, it is impossible to distinguish it from enlargement of the cervix due to congestive forms of disease. As the disease progresses, the carcinomatous degeneration advances rapidly; more and more tissue is involved; and the roof of the vagina becomes implicated, so that the uterus is fixed in a mass of new-growth. Before long a destructive process commences; portions of the growth slough and come away; hæmorrhage takes place from the opening of vessels; and, in advanced stages of the disease, the cervix may be entirely destroyed, and even the bladder or rectum opened, so as to form a common opening with the vagina. The epithelial variety of cancer commences on the mucous surface of the cervix by the growth of its villi into a papillary tumour, which, at first, it may be impossible to distinguish from similar growths of a benign character. It rapidly spreads, however, soon forming a fungating soft mass, not unlike the flower of a cauliflower in appearance; hence its popular name 'the cauliflower excrescence.' As in medullary carcinoma, destructive changes soon occur; ulceration progresses; and, as the disease advances, the neighbouring structures are implicated. When the disease involves the more deeply seated tissues, *post-mortem* examination shows that the malignant growth there assumes more of the character of medullary cancer.

Symptoms.—The earliest sign that arouses suspicion as to the existence of malignant disease is generally the occurrence of hæmorrhage, at first merely an excessive menstrual flow, subsequently loss of blood, sometimes very great in amount, at irregular intervals. Sometimes it is brought on by trivial causes, and a not infrequent complaint is that it always occurs after sexual intercourse. Excessive hæmorrhages, which are sometimes very alarming in amount, do not, as a rule, occur until advanced stages of the disease, when destruction of tissue is taking place. Another marked symptom is profuse discharge, often having a peculiar and pathognomonic fœtor, from the admixture of minute portions of sloughing tissue. In medullary carcinoma the discharge is not usually abundant, but it is sometimes very ichorous in character, producing excoriations, intense pruritus, or other disagreeable symptoms, in consequence of its irritating property. In epithelioma it is often very abundant, watery in character, and tinged with blood. Pain is sometimes excessive. The writer has often, however, seen cases terminate fatally without any pain at all. General constitutional disturbance soon results; the peculiar cachexia of malignant disease is developed; and the patient becomes sallow, emaciated, and extremely debilitated.

Diagnosis. — In advanced cases vaginal examination at once clears up the nature of the case. The cervix and roof of the vagina are infiltrated with the characteristic hard growth, and the uterus is quite fixed. If ulceration is advanced, the ragged broken edges of the cervix are apparent, bleeding on being touched, and breaking down under the finger. In a case of this kind mistake is hardly possible. In the earlier stages, before fixation and ulceration have advanced, error is easy, and it is far from uncommon to find non-malignant alterations of the cervix which have been mistaken for cancer, and even the reverse. Nothing but time will clear up such doubtful cases, and care should be taken not to give a positive diagnosis, unless the character of the case is marked and undoubted. The most difficult cases to diagnose are those in which the body of the uterus is alone affected. Here hæmorrhage, fœtid discharge, and recurrent attacks of spasmodic pain (probably caused by the efforts of the uterus to expel discharge collected in its cavity) may arouse suspicion; but nothing except dilatation of the cervix, and thorough exploration of the uterine cavity, can clear up the nature of the case. On account of the friability of the tissues, this must always be done with great caution. In epithelial cancer the soft, fungating, bleeding, and easily broken-down mass can hardly be mistaken for anything else.

Prognosis.—The prognosis is, of course, most unfavourable. There are, no doubt, a few authentic cases on record in which the patients have recovered after amputation of the cervix, but these are of the utmost rarity. In the vast majority death takes place, in a time varying from a few months to one or two years. Probably the disease advances most rapidly in younger patients, but few last longer than two years. Death takes place either from exhaustion, hæmorrhage, septicæmia, or some other complication. The writer has seen it on one or two occasions result from uræmia, the consequence of occlusion of the ureters through extension of the cancerous growth.

Treatment. — In the large majority of cases seen for the first time at an advanced stage, treatment must, of necessity, be palliative only. Here there are two chief indications — the maintenance of the general health; and the relief of pain, fœtor, or other distressing local complications. For the former we must rely mainly on a suitable diet, and the administration of some tonic which may be found to agree with the patient. The preparations of arsenic, as a rule, answer better than either iron or quinine. For the relief of pain the use of opiates, either in the form of morphine suppositories or administered subcutaneously, must be our sheet-anchor, and, when the pain is severe, it may be necessary to exhibit them in large doses. Fœtor may be best arrested by the local use of antiseptics. The plan which the writer has found to be most successful for the purpose is to introduce at night into the vagina a pledget of cotton wool, soaked in the glycerine of tannic acid, to which a small quantity of the glycerine of carbolic acid has been added, in the proportion of about one ounce of the latter to eight ounces of the former. This effectually destroys fœtor, while the astringent property of the tannic acid serves to check unduly rapid cell-growth, and prevent hæmorrhage. In the morning the vagina may be syringed out with a weak solution of permanganate of potassium. Iodoform pessaries are also extremely useful for this purpose. When hæmorrhage is excessive, local hæmostatics, such as the diluted solution of perchloride of iron, must be used, and, if necessary, the vagina plugged. Surgical treatment may be adopted in the hope either of entirely removing the disease, or of lessening the hæmorrhage and discharges, and so retarding its progress. Either indication is most easily fulfilled in epithelial cancer. When this is limited to the cervix, when there is a fair margin of healthy tissue between the diseased portion of the cervix and the body of the uterus, supra-vaginal amputation or amputation by the galvano-caustic wire or wire écraseur should be resorted to, the actual cautery being subsequently freely applied to the stump, to destroy, as much as possible, any infiltrated cancer-cells. Even when this fails to prevent the recurrence of the disease, it will certainly prolong the life of the patient, and increase her comfort. In other cases destruction of the exuberant growth, both in epithelial and medullary cancer, may be advantageously effected by local caustic applications, such as strong solutions of chloride of zinc, nitric acid, or bromine. The same object has been sought by excising the diseased tissue, or by scraping it away as much as possible by peculiar scoop-shaped curettes made for the purpose, after which one of the above-mentioned caustics, or the actual cautery, may be applied. It is in the epitheliomatous form of malignant disease that this procedure is most valuable, and a carefully performed operation may prolong life for months or years. Of late years vaginal extirpation of the uterus has been largely practised, and with fairly good results. This is, however, an operation of the greatest gravity, and it is only possible at an early stage of the disease, when the uterus is still mobile. It is clearly impossible to discuss its merits in an article of this description.

4. **Tumours.**—(1) *Fibroid Tumour.*—By far the most common variety of uterine tumours—so common that, according to some authorities, it is found in 60 per cent. of women who die after middle age—is the so-called fibroid tumour (myoma, fibroma).

Ætiology. — Fibroid tumours are most common after twenty years of age, and in certain races, the African especially, they occur with great frequency. Beyond this nothing is known of the causes which produce or favour their growth.

Anatomical Characters.—Fibromata are limited hypertrophies of the substance of the uterus, existing in the form of more or less globular tumours, contained loosely in a capsule of fibro-cellular tissue. Structurally they are homologous with the tissue of the uterus itself, consisting of connective tissue, mixed with unstriped muscular fibres. They are found of every size, varying from dimensions scarcely larger than a millet-seed, up to enormous masses weighing as much as fifty pounds. Most generally they occupy the fundus and body of the womb, and they are conveniently divided into three classes, according to the position they occupy, namely, the *sub-peritoneal*, occupying chiefly the outer surface of the uterus; the *intra-mural*, chiefly developed in the substance of the walls; and the *sub-mucous*, which project into its cavity; and these may be either completely sessile, with a broad base of attachment, or they may have become more or less pedunculated, and then approach in character to the fibroid polypi.

When once formed, the future progress of fibroids of the womb varies much. Generally they are of very slow growth, and although malignant degeneration of their structure has been observed in rare instances, they most commonly exist for the rest of the patient's life, without giving rise to any troublesome effects, beyond those resulting from mechanical pressure, provided they are not accompanied by hæmorrhage. They are, however, subject to certain occasional alterations, such as inflammation and even sloughing, when mechanically injured, fatty and calcareous degeneration, and even to complete absorption. The possibility of their entire spontaneous disappearance has been strongly questioned. The writer has published several instances coming under his own observation, and the fact is now pretty generally admitted, the explanation probably being that on account of similarity of texture to that of the tissues of the uterus, they are subject to a process of involution like that which the tissue of the uterus undergoes after delivery.

Symptoms.—The symptoms of fibroids of the womb depend to a great extent on their position. The sub-peritoneal and interstitial varieties, when not very large, are often unaccompanied by any symptoms whatever, and those that exist are chiefly the result of mechanical pressure, such as weight, difficulty in walking, irritability of the bladder, constipation, and the like. In the sub-mucous variety, the prominent symptom is hæmorrhage, which sometimes occurs to a very alarming extent, and may even put the patient's life in danger. The source of the hæmorrhage is probably, in the majority of cases, minute capillary vessels in the mucous membrane covering the tumour, which keeps up irritation and congestion in its neighbourhood. It is similar in its origin, therefore, to the discharge in menstruation, and is greatest in amount at the menstrual period. The more severe hæmorrhages are probably caused by openings in various vessels developed in the periphery of the tumour, where the vessels are increased in size, just as they are in pregnancy.

The physical signs vary with the size and situation of the tumours. If large enough to be perceptible on abdominal palpation, they have generally a more or less rounded or lobular outline, and a hard, firm feel, without any fluctuation, which serves to distinguish them from other varieties of abdominal growth. Small tumours, however, growing from the sides of the uterus, may be easily confounded with other conditions, especially flexions of the uterus, and deposits or exudations in its vicinity, such as hæmatocele, or pelvic cellulitis or peritonitis. The mobility of the uterus, which in the latter conditions is generally impaired, and the use of the uterine sound, which shows, in tumours, that the cavity of the uterus is considerably elongated, ought to enable us to avoid such mistakes.

Treatment.—The treatment resolves itself into *medical* and *surgical*. The former may be said to be powerless, all the so-called absorbents—iodides, bromides, preparations of calcium, Kreuznach and other waters, being admitted to be of no reliable value whatever. The subcutaneous injection of ergotin, in doses of half a grain to a grain daily, is said by Hildebrandt to be of great value, and is favourably spoken of by Atthill and other authors. It is, however, not reliable, and has often to be discontinued on account of the irritation produced by the injections. Of late years the treatment of such tumours by the electrical current, chiefly advocated by Apostoli, has been much discussed. It is claimed that electro-negative puncture has a decided effect in promoting absorption. The writer believes this to be frequently the case, but the procedure is not without risk, and it seems to him to be only permissible where the tumour is producing serious pressure-symptoms, such as retention of urine or the like. Surgical methods of treatment are chiefly called for when the hæmorrhages are excessive and exhausting. To discuss them at length is impossible in so limited a space, and the writer can do little more than merely enumerate them, referring the reader to systematic works for complete details.

(*a*) The hæmostatic effect of the electro-positive current applied to the uterine cavity by an insulated platinum or carbon sound the writer believes to be of great value. He has now seen numerous cases in which the most severe hæmorrhages have been controlled by this means. It apparently acts by hardening the mucous covering of the tumour. The writer is of opinion that no severe surgical procedure for hæmorrhagic fibroid is justifiable until this method has had a full and fair trial.

(*b*) Injection of *styptics* into the uterine cavity, such as tincture of iodine, or diluted tincture of the perchloride of iron, is valuable when the hæmorrhage is excessive, but is a plan which should not be tried unless the cervix has been previously dilated.

(*c*) *Incision of the cervix* is decidedly beneficial when the hæmorrhage is frequent and severe, and is supposed to act by allowing the uterine fibres to contract upon the tumour.

(*d*) *Incision of the capsule of the tumour* itself is useful in certain sessile tumours projecting into the uterine cavity, certainly diminishing the hæmorrhage, and facilitating subsequent enucleation.

(*e*) *Removal* of as much as possible of the tumour, with the écraseur or galvano-caustic wire, may be undertaken, when it is so situated as to be within reach.

(*f*) *Enucleation* is very valuable when the tumour is projecting into the uterine cavity, and is already partially separated from its attachments. Under such circumstances, it may be shelled out from its capsule *en masse.* The operation, however, is difficult and severe, and must be reserved for very urgent cases.

(*g*) *Gastrotomy*, with the removal of the mass of the tumour, and even of the entire uterus, is one of the most formidable of all operations, but one which has frequently been successfully performed, and which is justifiable when the patient's life is seriously endangered from uncontrollable hæmorrhage.

(*h*) The artificial production of the menopause by *removal of the uterine appendages* is an operation which has been highly recommended, and is chiefly valuable when the tumour is of small size.

(2) *Polypus.*—Polypus of the uterus may be considered in connexion with this subject, since the large majority of polypi are merely *fibroid* tumours, to a great extent enucleated from their capsules, and attached to the uterus by a narrow pedicle. There are, however, two other varieties described, the *glandular*, and the *cellular* polypi.

Anatomical Characters.—The *glandular* polypus is a localised hypertrophy of connective tissue, rarely larger than an egg, and generally attached to the cervix; the *cellular* is a hypertrophy of some of the glandular structures of the cervix, either of the Nabothian follicles or the utricular glands, and it is generally of small size. *Fibroid* polypi, like fibroid tumours, may be of any dimensions, but they are commonly met with about the size of a small pear.

Symptoms and Diagnosis. — Polypi are only important because of the hæmorrhage which so frequently accompanies them. When extruded from the cervix, or growing from it, they offer no difficulty in diagnosis. Nor is there any condition apt to be mistaken for them, except a chronic inversion of the womb, which can be readily differentiated by tracing the pedicle through the os, and finding that the sound enters the uterus to its usual depth. Intra-uterine polypi are much more difficult to discover, and here the only plan is complete dilatation of the cervix, and thorough exploration of the uterine cavity. This procedure is essential in all cases of severe hæmorrhage resisting ordinary hæmostatic treatment.

Treatment.—When once a polypus has been detected, the only treatment is its removal. In cases in which the polypus is chiefly in the vagina, this is easy enough, the wire of an écraseur being passed round the pedicle, which is separated in this way from its attachment. It is not essential that the wire should touch the base of the pedicle, since the part left, after the bulk of the polypus is removed, always shrivels up and disappears. In intra-uterine polypi it is sometimes difficult to pass the wire round the pedicle, but by thoroughly anæsthetising the patient, and using a single wire, it can generally be managed. No other method of removing polypi is so good. Excision may give rise to hæmorrhage, and the old method of ligature is dangerous from the risk of inducing septicæmia.

(3) *Fibro-cystic and Sarcomatous Tumours.*—The only other uterine growths requiring mention are the fibro-cystic tumours (cysto-fibroma, cysto-sarcoma), and the sarcomatous tumours.

The *fibro-cystic* tumour is specially important on account of its great resemblance to cystic tumours of the ovary, and the extreme difficulty of differential diagnosis, which is so great that probably there is no ovariotomist of any experience who has not mistaken the one for the other. The fibro-cystic tumour is a fibroid tumour of the uterus, generally of the sub-peritoneal variety, which has grown to a large size from the development of cysts in its substance. This is most usually effected by degeneration of its tissue, which becomes liquefied and transformed into an albumino-serous fluid. Thus we have a tumour partially solid, partially fluctuating—although rarely so distinctly so as an ovarian tumour—from which fluid can be drawn by an exploratory puncture, and which may attain dimensions, and produce constitutional effects, not less marked than those of ovarian cystic disease. The differential diagnosis may well baffle even the most expert gynæcologist. The sound may possibly enable us to ascertain the uterine character of the growth, as it enters for a considerable length, and on moving it the connexion of the tumour with the uterus may be demonstrated. Atthill has laid stress on the character of the fluid removed on puncture as diagnostic, since, unlike ovarian fluid, it coagulates spontaneously on standing, and on microscopic examination elongated fibre-cells, similar to those of the uterus itself, are found in it. The prognosis of these growths is unfavourable, since they produce all the evil effects of ovarian tumours, and the risk attending their removal by operation, which is the only available method of treatment, is much greater than that of ovariotomy.

Sarcomatous tumours of the uterus have been but little studied. They are in many respects like fibroid growths, but have a marked tendency to fungate and ulcerate, and to return after removal. Hence, they hold a place midway between the benign fibroid and the malignant cancerous growths, and they generally spring from the uterine tissue, like the sub-mucous fibroids, but without any distinct capsule. The symptoms are chiefly those of fibroid in that situation, namely, hæmorrhage; profuse watery discharges, and sometimes pain, probably the result of uterine contractions. The treatment must consist in the removal of as much as is possible of the tumour by the écraseur or galvano-caustic wire; and, if the nature of the tumour be ascertained, its attachment should be thoroughly cauterised with strong nitric acid.

W. S. Playfair.

WOMEN, Diseases of.—Synon.: Fr. *Maladies des Femmes*; Ger. *Frauenkrankheiten.*

The intention of this article is to indicate what is comprehended under its title: to define the proper limits of the subject; to show broadly the relations of the subject to general pathology; and to set out some connected points and general principles which could hardly be so usefully stated in the special articles into which the subject is necessarily subdivided.

It is impossible to draw an arbitrary line that shall clearly separate what are commonly regarded as the special diseases of women from the domain of general pathology. The study of the diseases centred in the sexual system of women is no more than the application of general pathology to this particular system. Any disease occurring in a woman will almost certainly involve some modifications in the work of her sexual system. On the other hand, the ordinary or disturbed work of her sexual system will influence the course of any disease which may assail her, however independent this disease may seem to be in its origin. Still, bearing in mind the foregoing fundamental facts, it may be stated broadly that the diseases of women embrace more especially those morbid processes and mechanical deviations of which the principal seat is in the sexual system, that is, in the ovaries, uterus, and breasts. Yet even this is a narrow and misleading view to take. It is no more possible to imagine an isolated pathology of the ovaries or uterus, than of the liver, kidney, or heart. If any one of these organs be damaged or working imperfectly, the blood, the nervous centres, the other organs, the whole body, suffer. No one organ can withdraw itself from its solidarity with the rest. And it is often an impossible task to analyse what appears at first sight to be a simple case, say of disease of the kidney, into its component elements, and to bring home to the kidney the initial fault. The controversy concerning arterial fibrosis, heart-disease, and Bright's disease, is a striking, but by no means exceptional, illustration of this proposition. The same thing is equally true of many apparently special disorders of the ovaries or uterus. The disturbance in function of these organs may be so obtrusively prominent that attention is concentrated upon them; and thus we may be led to regard them as the exclusive or principal seat of morbid action, and so to expend upon them our remedial care. The physician, in search of a diagnosis, is greatly guided by the observation of function. Disturbed function raises a presumption that the organ disturbed is itself at fault, and we are instinctively inclined to help that organ in its difficulty. But the primary or efficient cause may be elsewhere. This is as true of the ovaries and uterus as it is of the heart, kidney, or any other organ. One illustration will suffice. A woman suffers an abortion. There is the uterus obviously disturbed in its function, acting, in fact, in an improper manner. But we cannot in all cases affirm that the uterus is diseased. The causes of abortion are multitudinous. An efficient cause may indeed be found in some mechanical or structural fault of the uterus; but more often it will be found in the impeded work of some remote organ, or in an empoisoned state of the blood. Nor is any case often simple. Commonly several causes concur, local conditions acting and reacting upon each other. Thus, when the immediate cause is found in some alteration of tissue in the uterus, we may still have to look for the original cause in some antecedent constitutional disorder, for example, struma, or syphilis, inherited or acquired, or perhaps in some long-past transient morbid process, whose action can only be traced back—if traced at all—through the fallacious records and conjectures of history. Nor even then shall we be justified in concluding that we have discovered the whole secret of the abortion, that we are masters of the situation, able to take a right view of its clinical significance, and competent to deal with it on rational principles. Abortion is not seldom a conservative process, a remedy adopted by Nature to avert urgent distress in the circulation or in vital organs. There may be no appreciable disease in the uterus or embryo; but the embryo is cast out, the uterus is emptied, in order to relieve the system of a source of danger. Here, then, is proof of the danger of treating disorders of the sexual organs as a detached bit of pathology.

Here we may make particular application of a general law. The case may be formulated aphoristically. An organ so made to work against obstruction in excess, or in an unnatural manner, is prone to organic disease. This is remarkably true of the uterus. It may be said, indeed, that a very large proportion of the structural abnormalities of the uterus arise in this way. Hence the importance of looking at disturbed function, not necessarily as evidence of disease of its correlated organ, but always as a warning that disease of that organ is in course of induction or of aggravation. This applies most strongly to the history of dysmenorrhœa, in which the transition from physiology in difficulty into pathology is often conspicuously manifested.

The widest and perhaps the best definition of the subject is expressed in the word 'gynæcology.' It embraces, indeed, far more than is expressed in the term 'diseases of women.' In its full etymological meaning it is comprehensive beyond the strict domain of medicine; but experience and thought will show that it does not go beyond the philosophical conception of the care of the 'health of women.' Without accepting the doctrine of Michelet, that the life of woman is a history of disease, it is undeniable that to appreciate justly the pathology of woman we must observe her in all her social relations, study minutely her moral and intellectual characteristics—that we must, in short, never for a moment lose sight of those physical attributes which indelibly stamp her as woman, which direct, control, and limit the exercise of her faculties. This collateral study is of infinitely more importance in the pathological history of woman than it is in that of man. A very large, perhaps a preponderating, proportion of all the diseases to which women are subject, arise out of, or are in intimate reactive relation with, the play of her sexual system. The key to many of the disorders of women, especially of the nervous system, will be found here. The essence of her mental life is responsiveness; the emotional, the reflex, or diastaltic functions play an infinitely more active part than in man. It may further be said that the reciprocal action of the brain and spinal cord and ganglionic nerves is quicker and more intimate than in man, especially that the brain is more strictly subservient to the animal functions. Abstraction from corporeal impulse, initiation, enterprise, are masculine faculties.

There is one *primâ facie* limitation of the subject. The proper diseases of woman occur during her sexual life; that is, during the functional activity of the ovaries, uterus, and breasts. Before this epoch sets in, the female is not a woman, but a child; and when this epoch is over those organs shrivel up and no longer affect the system as before. Practically, however, the physical defects of the sexual organs in course of development, as in girls, and in course of atrophic degeneration, as in old women, are so closely related by continuity of history with their state in the epoch of functional activity, that all three epochs are but linked chapters of the same history. To cut out arbitrarily the consideration of the child and the old woman must needs invalidate our knowledge of the physiology and pathology of the woman proper. But for the gynæcologist this study need not embrace more than the development and diseases of the sexual organs. In the child, and up to the advent of puberty, these diseases are few, and may be regarded as accidental. The developmental faults even rarely acquire importance until the advent of puberty. Then, if the organs are faulty, and their relations to surrounding organs are abnormal, the performance of their functions may be so hindered that distress may ensue in the organs themselves, in their immediate surroundings, or in distant organs; or disorders of hæmatosis, nutrition, or other general processes may be induced. In the old woman the sexual organs, having fulfilled their functions, undergo what may be called senile atrophy. The ovaries, the uterus, the vagina often, and the breasts, shrink; they are no longer the centres of active nervous and blood distribution; they become inert, and henceforth exercise but feeble influence upon the general organism. Unhappily this normal course is not always observed. Towards the climacteric there is too often developed a tendency to certain morbid processes in the ovaries, uterus, vagina, and breasts, which compel the attention of the gynæcologist. Instead of undergoing what may be described as the normal process of quiet extinction, their tissues exhibit aberrant forms of nutrition and degeneration, as fibroma or cancer, and then again the pelvic organs become active foci of blood-distribution and growth, entailing local distress, and general, it may be life-imperilling, disorder. And even when no morbid tissue-change occurs, when the organs yield to the process of extinction, various phenomena commonly show themselves, always more or less distressing; and which often assume pathological import. The sexual apparatus no longer dominating the system, the balance of healthy action and reaction being lost, the nervous force not finding its long-accustomed use, wanders off in strange paths, and in its erratic play reveals various nervous phenomena, not seldom mistaken for special neuroses—as neuralgia, hysteria, syncopal attacks, or vertigo, or even convulsive attacks simulating or even merging into epilepsy, hemianæsthesia, or hemiplegia, single or combined, and mimicking apoplexy or paralysis; and various mental aberrations more or less rebellious to the will, a very common phenomenon being enfeebled memory and unsteady volition. Associated or not with some of the foregoing phenomena are various subjective phenomena of sensation. Illusive pregnancy—the *pseudocyesis* of Mason Good—is one of the most familiar. Others are certain peripheral sensations, as tingling, pricking, numbness of the limbs, chills and flushings, sometimes profuse perspirations, and itching—when occurring in the pudenda assuming the character of pruritus, in many cases associated with, and apparently dependent upon, irritating discharges from the uterus and vagina, the expression often of organic disease; in other cases with glycosuria, but in all probably with some perturbation of the glandular system. Here we see proof of the intimate connexion of innervation, nutrition, and glandular action. This origin of glycosuria is but one example of the influence of perverted or diverted nerve-force, in altering the constitution of the blood, and disturbing the work of the glandular organs. To trace these and their allied physiologico-pathological processes with any approach to completeness—and the theme is tempting—would lead us far beyond the narrow scope necessarily assigned to this article. Here we can only afford to give them a passing glance. One remark to emphasise the lesson the philosophical contemplation of them conveys is, that these phenomena, taken together, are integral parts of the play of the female economy, linking the climacteric and senile epochs of woman with that of her sexual vigour ; that, occurring as they do in subjects of known sound organisation, at a definite time and under conditions exceptionally easy to trace, they may be regarded as clinical experiments devised by Nature. An independent and strong light is thus thrown upon the genesis and nature of like disorders in the male, thus showing how what is called special pathology may help to solve many of the problems of general pathology. If we were to extend this reasoning so as to embrace illustrations from the processes of pregnancy and childbed, the argument would be greatly strengthened. We should see the strongest evidence that, since such affections as glycosuria and albuminuria may begin in subjects whose liver and kidneys are sound, and disappear leaving them sound, we may certainly infer in many cases, and so, presumably, in more, if not in all, that these and other aberrant processes do not depend for their origin upon change in the organic tissue of the organs which appear to be their immediate and necessary seats. These affections may be defined as evidences of disturbance in the work of the system. To regard them as disease is arbitrary and unphilosophical. It may then be safely affirmed that the study of gynæcology, pursued in a liberal spirit, bears the most instructive testimony to the law which declares that there is no proper boundary between physiology and pathology; that pathology is but a chapter in the history of physiology; a proposition which may be otherwise expressed by the aphorism: *Pathology is simply physiology in difficulty.*

We must bear in mind that all the great pathological processes may assail the ovaries, uterus, or breasts; that all the diatheses may stamp their work upon these organs. And this they may do apparently primarily or with especial activity; or secondarily, in the course of the development of the morbid process in other organs, or in the system at large. Thus we are familiar with cases of cancer starting to all appearance in the uterus; the disease from this centre or focus invading the surrounding structures, and empoisoning the blood. To form a just appreciation of these cases, it is obvious that a clear knowledge of the general history of cancer, as well as of its special local history, is necessary. A similar proposition may be affirmed with regard to struma, although the general and local relations may be more obscure. But the gynæcologist is familiar with the clinical fact that in a considerable proportion of cases of endometritis, of hyperplasia, and subinvolution of the uterus, and of perimetric inflammations and effusions, cure is extremely difficult—difficult beyond what his experience of simple uncomplicated cases of nominally the same kind would lead him to expect. He may safely assume that in a large proportion of these cases there is an underlying diathesis, frequently the strumous, which stamps its mark upon the tissues, modifying the progress of the morbid action, and challenging general as well as local therapeutical aid. In this connexion an incidental observation may be made. Some of the most obstinate cases of endometritis and hyperplasia the writer has met with were in women who had resided in the East, and whose constitutions had been damaged by endemic disease. These women had in fact acquired a diathesis deeply affecting the nutrition and the tissue-constitution of the body, which revealed its influence most conspicuously in the uterus, an organ whose integrity had been severely tested by pregnancy and the other conditions of married life.

Another law is of deep import, from a scientific as well as from a clinical point of view. Almost all the constituent elements of the body are represented in the uterus, modified of course in arrangement, and assuming certain peculiar characters in order to subserve the particular functions of the organ. But the modifications so acquired do not deprive these fundamental elements of their original and essential properties. By these fundamental properties these elements are attached indissolubly to general pathology; by these specially adapted modifications these elements become the seat of our so-called special pathology. Thus the fibro-muscular tissue of the uterus is liable to all those departures from the healthy type, as fibroma, myoma, fibro-myoma, hyperplasia, hypertrophy, and the degenerations to which like tissues elsewhere are liable. They may indeed assume special importance because, occurring in the uterus, they almost necessarily disorder the proper functions of the organ. They belong to the domain of general pathology nevertheless. But in this special disturbance of function we find the special aspect of the tissue-change. The retention of the essential properties of the component tissues of the body is strikingly manifested in the vascular, lymphatic, mucous, and connective tissues of the uterus. They are not only subject to the like physiological and pathological changes which the same tissues elsewhere are subject to; they link the pelvic organs to the general system partly by continuity of tissue, as especially in the case of the vascular, lymphatic, and connective tissues; but they carry morbific elements from the uterus into the general system by absorption. They thus are '*poison-routes*'—channels by which poison or noxious matter, forming in, or inoculated in, them, enters the blood, and thus empoisons the entire organism. It will not escape attention that the mucous membrane of the vagina and uterus is in pre-eminent degree exposed to contamination from external sources. It is needless to do more than refer to the direct infection from the gonorrhœal and syphilitic poisons. The gonorrhœal poison implanted on the mucous membrane of the vagina or cervix uteri sets up *in loco* its specific inflammation, and may spread along the mucous tract through the cavity of the uterus and the Fallopian tubes; and the empoisoned secretion, escaping into the abdominal cavity, may set up a severe form of pelvic or even general peritonitis. The syphilitic poison in like manner, first attacking the mucous membrane, may from this point of departure invade the general system. Then there are the more subtle instances of local and general syphilisation, through an ovum impregnated by the tainted male. The connective tissue again is of far more than merely local importance. Like the same tissue elsewhere, it is a most active poison-route, mainly, no doubt, through its relations with the lymphatic system.

There is a therapeutical corollary from this law that deserves earnest practical attention. A great part of the treatment of uterine diseases in which there is change of tissue, as hyperplasia of the mucous membrane and muscular wall, is surgical—that is, it consists in the topical application of caustics, absorbifacients or antiseptics, as iodine, mercury, carbolic acid, bromine, and so forth. These no doubt act in the first place directly *in loco* upon the tissues touched, modifying their state. But what is not so well known, and is rarely if ever designed or contemplated, is that some remedies so applied—notably iodine—are absorbed, and thus may affect the system. Under some conditions, as where the mucous surface is large, or when the epithelium-investment is lost, or where the quantity of the agent is large, and more especially when the absorbing function is in a state of peculiar activity, the general intoxication may be excessive, even dangerous. The writer has seen the most intense iodism produced in this way, and cases are recorded of poisoning by mercury and chromic acid. But if this law and the conditions under which it acts are borne in mind, remedies can generally be so applied as to draw from them both local and constitutional benefits in the happiest manner.

There are four modes in which iodine, for example, may invade the system: first, by imbibition or endosmosis, the tissues becoming permeated or soaked by the fluid; secondly, by absorption into the lymphatics and veins. There is a local iodism and a general iodism. By analysis we may resolve the complex action at work into the following factors: first, there is the direct mechanical or chemical action of the iodine upon the surface touched by it; secondly, there is the action upon the sub-mucous and muscular tissues of the uterus, the effect of their permeation; thirdly, there is the constitutional action upon distant organs, upon general tissue-nutrition, in which the tissues of the uterus share, the remedy being brought round again to it by the circulation; and fourthly, there is an action little thought of, from which the most useful effects have been often unconsciously drawn—namely, the antidotal action of the remedy topically applied upon certain septic matters originating in the uterus, and thence invading the system. The same channel that gave entrance to the poison is made to serve as a channel for the antidote. Thus the poison-route is in turn made a remedy-route, the antidote closely chasing the poison. The application of this principle is seen most strikingly in the treatment of syphilis and cancer, but it may be turned to useful account in the treatment of other morbid conditions.

Pregnancy and childbed constitute the most indisputable part of the territory assigned to the gynæcologist. In the careful study of the parturient process, we shall discover the secret of many of the disorders of menstruation, and arrive at a clearer understanding of the relations, physiological and pathological, of the sexual organs to the general system, than could otherwise be attained. This is to say, that the study of obstetrics is inseparable from the proper study of the diseases of women. Parturition is the culminating point in the functional work of the ovaries and uterus. All the other points in this work are subservient to parturition. It is true that in many cases this ultimate aim is not reached. But it is not the less true that this is the aim which Nature is always striving at. She may fail at any stage of the journey. Every menstrual nisus is truly a mimic or missed pregnancy. The points of analogy, or homology, are striking. Descending from the observation of parturition at term to the observation of premature delivery and abortion, we shall find strictly related and similar phenomena in ordinary menstruation; and then, passing from the ordinary or healthy type of parturition to the so-called abnormal types, again we shall find reproduced homologous processes in the various forms of paramenia, especially in dysmenorrhœa. And this is so true that the most effective principles of treatment flow from this comparative study. Many cases of nervous disorder, as vomiting, convulsion, neuralgia, such as we see in the most definite relation to pregnancy and childbed, have their exact counterparts in some forms of dysmenorrhœa; various blood-diseases, as anæmia, septicæmia, thrombosis, embolism, which we have so many sad opportunities of observing in childbed, are produced in the non-pregnant state from disturbed menstruation, or uterine disease, notably from cancer; blood-poisonings associated with glandular disorder or disease, as glycosuria, albuminuria, jaundice, simple and malignant, of which the most striking types occur in pregnancy and childbed, find their representation in the non-pregnant state.

Making liberal allowance for the proverbial difficulty of framing definitions that shall be proof against criticism, and against the infinite complications of natural history, we may cite the following as presenting a minimum view of the work of the gynæcologist. It embraces the study and treatment of the disorders and diseases of the female generative organs and their immediate surroundings—including pregnancy and parturition, and the disorders and lesions, general and local, which result from these processes.

We may set out some of these heads more particularly, as follows :—

Scheme of the Diseases of Women.

1. In infancy and childhood. Faults of development of the sexual organs; and the accidents from injury or disease to which they are liable.
2. At puberty and during the virginal state. Some of these are consequences of the developmental faults of the first order; others arise from functional difficulties, from diatheses, or accidental complications.
3. The normal and abnormal history of pregnancy and parturition.
4. The injuries and diseases consequent on parturition and childbed.
5. Mechanical or strictly surgical affections of the ovaries, uterus, and vagina, original or acquired. These include displacements or malformations of the uterus, and diseases of the ovary and broad ligaments.
6. The disorders of senility, subdivided into two classes: (*a*) Those of the climacteric, more immediately attending and following the menopause. (*b*) Those of senility proper.
7. Those general diseases which are strictly associated with error of function of the ovaries and uterus; and those cases of general disease, of which the chief action is expended upon these organs. The former will include cases of chloro-anæmia; and the latter cases of struma, syphilis, or cancer, affecting the ovaries, uterus, and vagina.
8. The diseases of the breast, as mastitis, and the conditions immediately connected with pregnancy, childhood, and lactation. Most of the other diseases of this organ have fallen by a natural process of selection to the surgeon.

The special diseases of women will be found fully discussed in other parts of this work, under their respective headings.

ROBERT BARNES.

WOODHALL, in Lincolnshire.—Common salt waters, containing iodine and bromine. *See* MINERAL WATERS.

WOOLSORTER'S DISEASE.—A form of anthrax. *See* PUSTULE, MALIGNANT.

WORD-BLINDNESS.—*See* APHASIA.

WORD-DEAFNESS.—*See* APHASIA.

WORMS.—This is a popular term, which in medical practice is applied in a restricted sense, as embracing only certain forms of entozoa or internal parasites that reside in the intestines. The word, as thus employed, originated from an entire misconception in regard to the supposed affinities subsisting between the round-worms or lumbricoids and common earth-worms. Structurally these kinds of creatures, though both vermiform, are essentially distinct. In a wider and purely technical sense, however, many distinguished zoologists (Gegenbauer, Rolleston) retain the term as an expression of high group value, embracing all sorts of annulose animals, parasitic and free. By some practitioners the employment of the term 'worms' merely signifies that a patient is suffering from ascarides or thread-worms. *See* ENTOZOA.

T. S. COBBOLD.

WRIST-DROP.—A form of paralysis, chiefly affecting the extensors and supinators of the wrist, and due almost exclusively to chronic lead-poisoning. *See* LEAD, Poisoning by.

WRITER'S CRAMP.—SYNON.: Scrivener's Palsy; Fr. *Crampe des Écrivains*; Ger. *Schreibekrampf.*

This disease may be taken as the most common form and most typical representative of a class of diseases which Duchenne has called 'functional impotences.' In them we find the patient complaining of inability to execute some complicated act, the power to perform which had taken him perhaps years (in the case of writing) to acquire. As a rule there is no other trouble, and, as far as the patient's observation goes, all muscular acts, however delicate or however complicated, are accomplished without difficulty, with the exception of one, which unfortunately is usually that with which the patient earns his living. Not only have cases of 'writer's cramp' been described, but English and foreign physicians have furnished accounts of 'piano-player's cramp,' in which an inability to strike chords with correctness is present; of violinists who have lost the power of holding the violin, and fingering with the left hand; of violoncello-players who have become powerless to 'make the nut' with the phalangeal joint of the left thumb; of tailors who can no longer use the needle; of dairymen who fail in milking; of bricklayers who cannot wield the trowel; of smiths who cannot use the hammer; of compositors who cannot place the type; and lately we have had accounts of telegraphists who have become unable any longer to work at their calling. 'Writer's cramp,' however, is by far the most common of these diseases, and while the others mentioned must be regarded as the rarest of medical curiosities, the one which has been chosen to illustrate the class is tolerably often met with.

SYMPTOMS AND COURSE.—The symptoms and course in a typical case of writer's cramp are as follows: A clerk, who from his painstaking and energetic habits has been tempted by his employers to work over-time or possibly against time, and who perhaps (as the history of these cases often shows) is harassed by domestic troubles, discovers that he does not write quite as easily as he did, that his hand possibly aches after prolonged writing, and he finds it convenient to adopt some new method of holding his pen. At first the trouble is hardly noticeable, and then he finds himself obliged to grasp his pen with unusual tightness to prevent its becoming unsteady. Then his handwriting begins to suffer; perhaps his forefinger refuses to remain steadily upon the penholder, and while he is making every effort to control it, the pen somehow or other eludes his grasp and falls from his hand. If he persevere—probably he is one of those who would sooner die than give in—his progress downhill is rapid and certain. Every possible method of holding the pen is adopted by turns, such as interlacing it between the fingers, grasping it firmly with the whole hand, using only the first and second fingers without the thumb, or the thumb and second finger without the first; but these subterfuges quickly fail to be of service. He cannot steady the pen by means of them, and he finds that the arm rolls possibly inwards or outwards, and that he can only form his letters by moving the whole arm from the shoulder, or lastly by fixing the arm to the side and swaying the whole body to and fro. The handwriting soon becomes illegible; and lastly the patient is almost unable, even by the most strenuous efforts, to make a mark upon paper. To write a word legibly in extreme cases is impossible, and there are few spectacles more distressing than to see a patient, whose handwriting was perhaps his means of livelihood, drip with perspiration while making an ineffectual effort to sign his name. His loss of writing power may be his only symptom, as was the case with an American sufferer who wrote thus to the writer: 'that fingers which could guide razor and needle, wield oar and musket, and, though numb with cold, knot and cast off reef-points on a wet sail, should yet strike work when called on for the familiar character of their owner's name, seemed utterly beyond comprehension.' Patients should be closely questioned as to their ability to perform acts other than writing. In the writer's experience it is usual to find that some other act or acts is affected. If the patient be asked if he can wind up his watch, carry a full teaspoon steadily to his mouth, or perform some similar act requiring a *delicate* use of the thumb and forefinger, it will very commonly be found that he has lost his deftness in performing such acts, although in using a knife or wielding a hammer, and other work requiring a coarse use of muscles other than those used in writing, he may find no difficulty whatever. Frequently there are neuralgic pains, or a sense of extreme fatigue in the hand and arm; and in some cases the effort to write has been followed by pain in the back, or severe headache. In some cases the mental distress caused by the loss of power has produced a condition bordering on melancholia. Slight tremor of the hand is not uncommon, and these tremors sometimes occur independently of writing. Tenderness of the nerve-trunks (median, ulnar, or musculo-spiral) is very often present, and should always be carefully looked for, as indicative of congestion of the nerves, or neuritis. Occasionally there is objective spasm of some of the muscles of the arm when the effort to write is made; and one case has been reported by the writer, in which the symptoms, at first those of simple loss of writing power, terminated in a general clonic spasm of all the muscles of the arm, occurring at last independently of any writing effort.

Although the above is a fair statement of what occurs in a typical case of 'writer's cramp,' other cases are by no means uncommon, in which impairment of writing power supervenes quite independently of any unusual writing effort, and even in persons who have done rather less than an average amount of writing. These latter cases are not usually so severe as the former, since they are not obliged, as is the professional scrivener, to goad the unwilling hand to make those efforts which are so detrimental. It has been the writer's experience, too, that in this latter class of cases it is more usual than in the former to find that the trouble is not very strictly limited to the act of writing, but that there is a certain amount of inability or clumsiness in the performance of other acts requiring minuteness and nicety.

A difficulty in writing is, in fact, a symptom of many conditions, and it is doubtful whether 'writer's cramp' can be regarded as a morbid entity. When patients come complaining of loss of writing power, it is always essential to examine them with great care, with a view to discover any changes in the nervous system, whether central or peripheral. The writer has found that difficulty in writing may be part of a scarcely noticeable hemiplegia (congenital or otherwise) depending on the usual brain-lesions, or an early symptom of general paralysis, or paralysis agitans, or disseminated sclerosis; he has found it depending upon mischief in, or connected with, the spinal cord, such as sclerosis of one or other of the columns (anterior, lateral, or posterior), meningeal thickenings, tumours, or disease of the bones; he has known it caused by an aneurysm pressing on the brachial plexus, by neuritis affecting either the large nerve-trunks or the small terminal twigs that run in the palm of the hand; he has known it caused by rheumatic thickenings of muscular attachments, by injury or disease of the muscles themselves, or by gouty deposits in the sheaths of the tendons. It is therefore necessary to examine these cases with very great care, and to remember that the act of writing may be hampered by the failure of any muscle between the scapula and the hand.

Pathology. — The morbid anatomy of writer's cramp is unknown, and consequently the pathology of the disease is a matter of speculation. Dr. Reynolds says: 'It cannot be doubted that some changes take place in the nutrition of the parts through which the lines of nerve-action regulating the secondarily automatic movements run. It seems probable that the association of movements is effected by ganglia which are common to fibres passing through distinct but contiguous nerve-trunks, and that it is owing to some nutritive change in them, the result of persevering and forced effort, that the perfection of movement is produced; associations at first caused by the will are at length produced unconsciously. What happens, then, in such maladies as writer's cramp is a perverted nutrition of these parts.' Duchenne believes that the change is in the nerve-centres first, because localised faradisation applied to the hands has no good effect on the trouble; and he is confirmed in this opinion because the malady very quickly affects the left hand if it be used to supply the place of the right. The writer has ventured to suggest that the lesion is, in typical cases at least, situated at the periphery, either in the muscles themselves, or in the terminal motor nerves supplying these muscles. In real cases of writer's cramp (the loss of writing power occurring in an overworked scrivener) it is rare to find any sign of central change; neither wasting or true paralysis of muscle, nor fibrillary tremor, nor general tremor of the limb, nor pain, nor spasm (except during, or immediately after, the attempt to write). It is generally observed that the disease progresses from the periphery towards the centre; that the muscles of the fingers are the first to fail, then those of the forearm, then those of the arm, and lastly, in extreme cases, those of the trunk. It is probable that the muscles of pen-prehension, as opposed to those of pen-movement (consisting of the adductor pollicis, first dorsal interosseous, &c.) drift into a condition of 'chronic fatigue' owing to the *prolonged strain* to which they are subjected when holding a pen for long periods at a time. When these normal muscles of pen-prehension are exhausted, others are used to supply their place, such as the superficial and deep flexors in the forearm, which in their turn give out, and thus the trouble steadily progresses. The writer has had no small experience of this disease, and he has rarely failed to find that a careful electrical investigation of the muscles has shown a certain diminished irritability to faradisation in the muscles of pen-prehension on the diseased side, when compared with those of the sound side. This loss of irritability is due, in many cases, he believes, to sheer over-use of the muscles, the intervals of relaxation between the long periods of contraction not being sufficient to allow of their proper nutrition. In many cases of 'writer's cramp' no over-use of the muscles has taken place, and in such cases we must suppose that, from some condition, either constitutional or situated locally in the nerves, the muscles are so deficient in 'staying power' (notwithstanding their ability to contract forcibly for a short time) that they become useless, or nearly so, when called on for prolonged steady contraction. It is obvious that the failure of one muscle (however small) which had been taught, by years of laborious education, to act in harmony with many others for the accomplishing of a complicated and delicate act, such as writing, would produce a true want of coördination. In other words, muscles which have been induced *to work in order together* no longer do so if one of them fails, and the failure of one must be fatal to the accomplishment of the coördinated act.

Diagnosis.—Diagnosis is of great importance, since failure of writing power is often an early symptom of disease the prognosis of which is very different from that of 'writer's cramp.' Evidence of chronic alcoholism is often afforded by the handwriting. So again paralysis agitans and disseminated sclerosis of the spinal cord may very early give a want of steadiness to the pen. Dr. Reynolds records a case of lead-palsy, which was sent to him as a case of writer's cramp. Paralysis of any of the nerves supplying the hand or forearm, such as the ulnar, median, or musculo-spiral, will make writing difficult; and the writer has seen cases of progressive muscular atrophy, in which the shrunken and quivering interossei had made a firm grasp of the pen impossible.

Treatment.—The chief remedy is rest. Without it nothing can be done; and if rest be taken in the earliest stages of the disease, complete recovery not infrequently results. For such writing as is absolutely necessary, the patient should be advised to use a pencil or soft quill pen, so that any violent grasp becomes impossible. In many cases the writer has found the rhythmical exercise of those muscles whose irritability is impaired, together with the employment of a mild galvanic current, of the greatest service, and he has recorded a few cases treated in this way which rapidly improved after having resisted every other known method of treatment for years. Injection of morphine is of no use, but in America some good has been said to result from the injection of atropine. Systematic massage is of decided service in many of these cases, but neither massage nor electrical treatment must be employed so long as the nerve-trunks are tender. The first object in the treatment of such cases is to remove the nerve tenderness by rest and blistering. The administration of a very small dose (gr. i) of iodide of potassium combined with arsenical solution is often useful to this end; and when the tenderness has disappeared, the systematic rubbing of the muscles, especially the muscles of the hand, is most valuable. No patent penholders are of any permanent use in these cases, although they may do apparent good by shifting the burden of writing on to a new group of muscles, which are sure, if writing be persevered with, to break down in time. 'Type-writers' are, of course, invaluable to sufferers from writer's cramp, but only those forms of type-writers which are worked by a piano-like keyboard are admissible. Those which necessitate a prolonged grasp of a handle are dangerous for sufferers from this disease.

G. V. Poore.

WRY-NECK. — Synon.: Torticollis; Fr. *Torticolis*; Ger. *Steifer Hals.*

Definition.—A twisting of the neck to one side.

Ætiology. — Wry-neck is a symptom which may be produced by very different conditions; and it is usual to distinguish between the varieties of this disease, which may either be *congenital* or *acquired.*

The *congenital wry-neck* arises either from faulty development of the muscles on one side of the neck (in which case there are not infrequently evidences of faulty development in other regions of the body, and notably in the neighbouring parts, such as the face); or from contraction of the muscles on one side, often due to accidental injury during labour. Dr. Herbert Spencer found no less than sixteen cases of hæmatoma of the sterno-mastoid in 200 bodies of still-born children, and Mr. D'Arcy Power has insisted upon the connexion between such congenital tumours and wry-neck. In these cases the head is fixed in its abnormal position. *Acquired wry-neck* may be a mere passing condition, due to 'muscular rheumatism,' brought on by exposure to cold, and under the name of 'stiff-neck' it is familiar to everybody (*see* Rheumatism, Muscular). The most formidable variety is *spasmodic wry-neck*, which makes its appearance, usually in persons otherwise healthy, about the middle period of life. The muscles on one side of the neck are the seat of spasm, sometimes tonic, but usually clonic, in character. The muscle chiefly affected is generally the sterno-cleido-mastoid, and its constantly recurring contractions have the effect of turning the head away from the side which is the seat of spasm; drawing the occiput slightly downwards, and the chin slightly upwards. Other muscles, such as the scaleni, splenius, and trapezius, are not infrequently affected also; and then, in addition to the rotatory twisting of the neck, we get a lateral downward bending, and an elevation of the shoulder. At the commencement of the disease the trouble may be slight, and cause but a trifling amount of inconvenience, the impressions produced on a bystander being that the patient's movements are caused by some mal-arrangement of the dress, which he is seeking to remedy. In its advanced form the disease is a very terrible one, and may make life hardly supportable. The writer has seen one case in which the spasm was so violent, that the constant forcible impinging of the chin upon the shoulder of the sound side had produced a sore place as big as a shilling. The spasm ceases during sleep; and when the patient is undisturbed, and his mind pre-occupied, it is not unusual, even in the worst cases, for considerable remissions of the symptoms to occur. In the presence of others, especially strangers, the spasm is usually intensified, and in this it presents a striking similarity to stammering and writer's cramp.

Pathology.—The pathology of spasmodic torticollis is very doubtful. It must be regarded in almost all cases as a true neurosis, and must take its stand alongside of histrionic spasm of the face, writer's cramp, and stammering. It must often be a question as to whether some of these cases are not definitely of cerebral origin. The rotation of the head to one side is affected by muscles on *both* sides of the body. Thus the right splenus capitis and the left sterno-mastoid, acting in concert, rotate the head to the right; and in many cases of clonic torticollis it is found that muscles on opposite sides of the body are both conspiring to produce the rotation. The writer has recorded one case in which extreme torticollis was associated with a history of injury to the head close to the upper end of the Rolandic area, combined with a history of syphilis. This case was practically cured by the free administration of mercury. That it is due in many cases to an irritable condition of the spinal accessory nerve there can be no doubt, but how this condition of nerve is brought about we are unable to say. In many cases, especially in women, there is a large element of what is called a pure neurosis. Want of proper antagonisation is another factor which is always present, for without it the symptoms could not occur. In certain nervous constitutions a weakened action of one sterno-mastoid would seem of itself to be almost sufficient to excite irregular contractions in its fellow. The writer has seen one case in which it seemed tolerably clear that the sterno-mastoid and trapezius on one side had become weakened by overwork, and had drifted into a condition of chronic fatigue, while their antagonists were constantly in a state of clonic spasm, twisting the neck to the weakened side. An electrical examination of the muscles may show that, while those which are the seat of spasm have their irritability greatly increased, their antagonists are below their normal state as to irritability. Torticollis is usually, but not always, uncomplicated. That condition known as 'irritable spine' has been observed in some few female patients; histrionic spasm, or spasm of the limbs, has occurred as a complication, and it is not a little remarkable, as showing connexion between the two diseases, that Dr. Reynolds has recorded three cases of torticollis in which the patient had suffered previously from writer's cramp. A difficulty of deglutition was observed in one of Dr. Reynolds's cases; and in another there was swelling of the arm, from pressure upon the subclavian vein.

Prognosis.—The prognosis of these cases is bad, it being very unusual for recovery to take place after the disease has become well established.

Diagnosis.—The diagnosis of wry-neck, as a rule, is not difficult, but care must be taken that simple torticollis is not confounded with cases of caries of the cervical spine, in which there is frequently a tendency for the head to twist to one side. It should be borne in mind, also, that in some few cases of organic brain-disease, in which synergic movements of the eyeballs have occurred, a spasmodic rhythmic movement of the neck has also been observed. The other symptoms of brain-disease, however, would usually prevent any such mistake.

Treatment.—This necessarily depends upon the cause of wry-neck. In those cases in which the head is fixed by contraction or faulty development of the muscles, tenotomy has been of service. Tenotomy has been practised also in those cases in which there has been definite clonic spasm; but notwithstanding that temporary relief has in some cases followed, it has been found that the deep-lying muscles are almost certain to take on a spasmodic action, and that in the end the patient's discomfort is increased rather than diminished. A tenotomised muscle is liable to shorten; and it has appeared to have been the case that, although tenotomy gives temporary relief, it really aggravates the trouble in the long run.

The removal of a piece of the spinal accessory nerve in the neck, as practised by Mr. Campbell de Morgan and others, will completely paralyse the sterno-mastoid and upper part of the trapezius, and is not open to the objection urged against tenotomy. This manœuvre is stated to have given great relief even in those cases where muscles other than those supplied by the spinal accessory have been implicated. Various mechanical contrivances for steadying the head have been devised, but few patients are able to bear the constant pressure of the apparatus, and the remedy has been found in most cases worse than the disease. The stretching of the spinal accessory, the ligatûre of the same nerve (Collier), and the suspension of the patient by the head, are all measures which are calculated to relieve. Some good has resulted from the long-continued use of hypodermic injections of morphine, and the exhibition of large doses (℥j. and over) of the succus conii. Electricity has not been particularly serviceable in the treatment of torticollis. The galvanic current has been used to control the spasm, while the weakened antagonising muscles have been stimulated by faradisation; and although improvement has been produced by these means, it has generally been of very short duration. The writer some years ago had a very severe case under his charge, which was successfully treated by the employment of the continuous galvanic current, combined with the rhythmical exercise of the affected muscles. The positive pole being placed behind the ear, the negative pole was applied over the sterno-mastoid and trapezius, and at the same time the patient was made to exercise these muscles by shrugging the shoulder, twisting the head, and other movements. The result was very rapid and permanent improvement. Another case, also, was successfully treated by the writer by faradising the antagonist muscles, which were somewhat wasted and decidedly deficient in irritability. This patient completely recovered; although tenotomy of the sterno-mastoid, which was the seat of spasm, had afforded only temporary relief.

G. V. Poore.

WYNBERG, a suburb of Cape Town, in Cape Colony.—*See* Africa, South.

X

XANTHELASMA (*ξανθὸς*, yellow; and *ἔλασμα*, a lamina).—A yellow growth in the superficial layer of the skin, assuming the form of a lamina or plate, and more frequently met with in the eyelids than elsewhere. *See* Xanthoma.

XANTHOMA (*ξανθὸς*, yellow).—Synon.: Xanthelasma; Vitiligoidea; Fr. *Molluscum Cholestérique* (Bazin); Ger. *Fibroma Lipomatodes* (Virchow).

Definition.—A rare disease, characterised by a peculiar kind of yellow growth, in the form of plates or raised tubercles, in the skin, and sometimes subsequently in areolo-fibrous tissue elsewhere.

Ætiology.—The presence of xanthoma is frequently associated with megrim or other neuralgiæ, with gouty conditions, and with disorders of menstruation. It occurs in such frequent connexion with those morbid functional conditions or actual organic diseases of the liver which lead to the presence of jaundice, that the influence of this as an ætiological factor cannot be gainsaid, although the nature of the relationship is not apparent. These conditions are, in order of probable relative frequency, chronic catarrh of the bile-ducts, hypertrophic cirrhosis, biliary calculi, atrophic cirrhosis, hydatids, and carcinoma. Chronic dyspepsia, lithæmia, and other conditions attributed to hepatic disturbance are also often present. In the great majority of cases jaundice precedes xanthoma by a prolonged period—usually a year or more—and is generally present when it develops. In a certain number of instances, however, all signs of jaundice may have disappeared, while in others—noted especially by French writers—a persistent yellowish tint of skin (*xanthochromia*), not identical with jaundice, and unaccompanied by other evidences of bile-absorption, has been noted. On the other hand, xanthoma is frequently seen in persons apparently healthy in every other respect.

The female sex is much more frequently affected than the male, in the proportion, according to Hutchinson, of three to two. Xanthoma generally begins about or above the age of forty years, but a dozen cases or more are recorded in children below puberty. These have never been in association with jaundice, but many have been either congenital or hereditary, while the existence of the disease in several members of the same family, and even in successive generations, is sometimes striking. 'Probably slight developments of xanthoma are not so rare as is generally supposed, but give rise to no trouble, and are generally overlooked' (Crocker). Such cases are often unilateral.

Anatomical Characters.—The following description of xanthoma is based upon the examination of growths in the skin alone.

The upper epidermic layers are healthy, but there is usually a small quantity of granular pigmentary deposit in the rete Malpighii. The changes in the papillary layer are slight, but in the middle and lower layers of the derma there is a good deal of yellowish-brown pigment, both free and in cells. The most prominent and characteristic feature, however, is the involvement of these latter layers by a new-growth of connective tissue, the amount of which is small in the flat, and great in the tuberous, variety. In the meshes of the fibres there are numerous round, oval, or polygonal, multinuclear or granular, epithelioid cells, which vary greatly in size. Often they are arranged in masses surrounding blood-vessels or sebaceous glands. These cells, which may be considered as characteristic 'xanthoma cells,' contain many cholesterin and tyrosin crystals, as well as yellowish pigment and fat, the latter being also abundant in the connective tissue.

There is much difference of opinion as to whether the diseased process ought to be considered a purely neoplastic or a low inflammatory one, but the presence of large endothelial and giant cells, as well as of the changes in the arterial walls usually associated with chronic inflammation, described by Chambard and others, seems to turn the balance in favour of the latter view. The papules are not due to a collection of sebum within the follicles, as Hebra suggested.

Symptoms and Course.—Two types of xanthoma, (1) the *flat*, and (2) the *tubercular*, are usually recognised, but as the differences between them are mainly of degree, and do not turn upon essential characters, they are separately described only in accordance with custom.

1. *Flat or localised xanthoma* (*x. planum*) is the much more frequent form, and the great majority of cases do not call for medical relief. It generally occurs in middle-aged or older women, especially in those of dark complexion or who suffer from neuralgia or 'any conditions capable of producing dark areolæ round the eyes' (Hutchinson). In the immense majority of cases the disease is situated upon the eyelids, where it generally begins on the left side, above and a little outside the inner canthus. Thence it extends slowly outwards along the upper lid and more slowly downwards to and along the lower lid, so that in extreme cases the eye may be surrounded by a xanthomatous ring. After a variable time the right side becomes similarly affected, and the disease pursues the same course as on the left side. The patches when first noticed vary in size from a pin's head to a pea; they are deeply embedded in the skin, which undergoes no alteration in consistence and suppleness; they vary in colour from the palest yellowish-white—to recognise which the blood of the part must be expressed by the finger—to a bright orange or dark brownish buff; and have been not inaptly described as like pieces of chamois leather 'let into' the skin. With a lens the patches can be seen to be composed of fine yellowish granules. At the spreading margin they are sometimes well defined, sometimes they are irregularly serrated, while at other times their colour gradually merges into that of the surrounding skin. Occasionally slight irritation is present, and when the eyes are encircled there may be some *gêne* in the movements of the eyelids; with these exceptions no subjective symptoms are present. Single patches of flat xanthoma have in rare cases been noted on the ear, neck, chest, penis, prepuce, and tongue.

2. *Tubercular or multiple xanthoma* (*x. tuberosum, multiplex*) is of greater rarity and more serious import than the previous type. It is also much more frequent in women than in men, especially in those who suffer, or have suffered, from jaundice. Although it may occur independently, it usually shows itself in persons suffering from flat xanthoma of the eyelids, and not infrequently the first step towards its establishment is the appearance of flat lesions on the face, other than those on the eyelids, especially about the nostrils, mouth, or external auditory meatus. The most characteristic and tuberous lesions are situated on the extremities, especially on their extensor surfaces and on points much subjected to pressure, such as the tips of the elbows and knees, buttocks, shoulders, and backs of the fingers. The colour of the tubercles varies within the same wide limits as that of the lesions of the plane variety, but often they have tufts of dilated blood-vessels round or over them. In size they vary from a hemp-seed to a pea, but, by their coalescence, swellings as large as a hen's egg, or even larger, may be produced. The epidermis over these is, however, intact, and they are usually only slightly tender to touch and manipulation; occasionally they itch or tingle a little. In most cases a few flat lesions exist here and there over the chest and abdomen, and are present in greater numbers over the palms and soles, where they are ranged in rows along the naturally deep lines of the parts, which they exaggerate. Sometimes they are similarly arranged in concentric circles round the anus. On the trunk they occasionally have the unilateral nerve-distribution of a zoster. The development of the lesions is usually very slow—extending over years; and ultimately flat xanthoma may show itself in the mucous membrane of the lips, cheeks, gums, tongue, fauces, pharynx, œsophagus, stomach, bile-ducts, intestine, peritoneum, conjunctiva, larynx, trachea, bronchi, pleura, on the endothelium of the heart or great arteries, and on tendons.

Xanthoma in children presents some such well-marked peculiarities as to merit a few words of special mention. It has never been known to be associated with jaundice, but is often so with gout or rheumatism, while it is frequently hereditary, may affect several members of the same family, and is occasionally congenital. The lesions are generally a symmetrical, often unilateral, markedly tuberose; and the eyelids are comparatively seldom attacked.

Diagnosis.—Flat xanthoma may be confounded with *milium* if the little, projecting, whitish masses of inspissated sebum which characterise that disease are thickly grouped together so as to form a conglomerate plaque. Almost invariably, however, a few characteristic outlying lesions are present. In any case the sebaceous contents of a milium can always be squeezed out after a shallow incision has been made, whereas in xanthoma the lesions are deeply situated in the corium, and cannot be expressed. It will suffice to mention the possibility of errors in diagnosis with *flat warts* and *colloid degeneration of the skin.*

In the diagnosis of multiple xanthoma the presence or history of jaundice is an important factor. The dermatosis which most closely simulates it is *urticaria pigmentosa* (hence called *xanthelasmoidea* by Tilbury Fox), but the history, distribution, and subjective symptoms of the two diseases easily serve to distinguish them.

Prognosis.—In the great majority of cases xanthoma progresses slowly but steadily for months or years, and afterwards persists unchanged. In at least four instances, however, very gradual spontaneous recovery has been known to occur, the skin regaining its normal characters. In a very small number of cases death has been attributed to patches on the endothelium of the heart or great arteries.

Treatment. — Treatment is seldom resorted to except for the removal of disfiguring plaques from the eyelids. This can only be accomplished by excision, and great care is necessary not to cut too deeply, and thus give rise to subsequent ectropion or epiphora. A 10 per cent. solution of perchloride of mercury in collodion has been successfully used by Stern for the cauterisation of painful masses on the elbows; while Kaposi states that he has removed xanthoma tubercles from the palms and soles by repeated vigorous washing with soft soap, and making the patients wear indiarubber gloves and socks. Internal treatment is of no use.

J. J. Pringle.

XANTHOMA DIABETICORUM.

Synon.: *X. Glycosuricum*; *Lichen Diabeticus.*—Although this lately recognised and rare condition—the identity of which was first clearly established by Malcolm Morris in 1883—is now by universal consent considered as a member of the xanthoma group, it presents several points of distinction which entitle it to separate description, in which its chief clinical characters may conveniently be contrasted with those of ordinary xanthoma. The following conclusions have been arrived at from a study of the seventeen indubitable cases on record, a considerable majority of which (fifteen to two) have occurred in males, the age of the persons affected ranging from seventeen to forty-eight years.

Course and Symptoms. — The disease almost invariably occurs in people actually passing sugar in the urine, although generally they have been noted as stout and apparently in good health. In the majority of the cases the presence of sugar in the urine has been transitory, and unaccompanied by the other phenomena of true diabetes mellitus. In one case, moreover (Cavafy's), there was only a history of antecedent glycosuria; while in another (Besnier's), who was an obese man without glycosuria, the father of the patient was diabetic. The eruption evolves quickly, and, after a variable stationary period extending over months or years, diminishes with considerable rapidity, to ultimately disappear without leaving any trace of its existence. Sometimes its course is intermittent and successive outbreaks occur, while occasionally fresh lesions develop during the retrocession of older ones. As a rule the parts first affected are the extensor surfaces of the limbs, especially of the forearms; subsequently the lesions usually appear on the elbows and knees, where they have a great tendency to become confluent and form raised plaques. They are commonest on extensor surfaces, the buttocks, back, face, scalp, mucous membrane of the mouth, and bends of the ankles, but they do not generally affect the flexures. They have only once been observed on the eyelids, and the presence of jaundice has never been noted. The constituent tubercles are much firmer and denser than those of ordinary xanthoma, are well defined, rounded or obtusely conical at the apex, and may present a yellow point like pus at the summit, but are in reality solid; often there is a bright zone of congestion round their base. In some cases the tubercles are very pale, while in others their colour is pink rather than yellow. Itching and tingling are always troublesome, and occasionally there is great tenderness, while neuralgic pains sometimes precede the eruption.

Anatomical Characters. — Recent researches establish the close relationship between ordinary and diabetic xanthoma; 'discrepancies in the recorded appearances being fully accounted for by variations in the rate of the inflammatory process and differences in the methods of hardening and staining employed' (Morris). Typical xanthoma cells are present, albeit in less abundance than in flat xanthoma, while the inflammatory changes are more marked, especially in connexion with sebaceous and sweat glands. They also extend upwards to involve the papillary layer, and the passage of fat even into the epidermis has been noted.

Treatment.—Mild tarry or lead lotions, separate or combined, generally suffice to allay or moderate the itching. If sugar disappear from the urine under the influence of dietetic or other measures (codeine, salicylate of sodium, &c.) the eruption usually soon disappears.

J. J. Pringle.

XERODERMA PIGMENTOSUM.

Synon.: *Atrophoderma Pigmentosum.*

Description.—This is a very rare disease, which almost invariably commences in the second year of life. Without any previous symptoms or apparent cause, but sometimes preceded by a morbiliform or patchy erythema, a copious outbreak of freckle-like pigmentation appears on the face, neck, and upper extremities, in the uncovered parts, in short, reaching about halfway up the upper arms, the legs being sometimes slightly involved. Other lesions follow, namely, telangiectases, white atrophic areas, pigmented flat warts, ulcerations—on which papillomatous growths form, and, if not removed, become even epitheliomatous, and thus lead to the patient's death. Conjunctivitis and pterygium are nearly always present, and the discharge is largely responsible for the onset of the ulcers. Cicatricial contraction of the various lesions produces much disfigurement. The ætiology and pathology are unknown. The ultimate prognosis is bad; but the disease progresses very slowly, and if the eye affections are effectually treated from time to time, the ulcers scraped with a sharp spoon, and all soft papillomatous growths promptly removed, the cancerous stage may be averted for an indefinite period. Internal treatment is unavailing.

H. RADCLIFFE CROCKER.

XEROPHTHALMIA (ξηρός, dry; and ὀφθαλμός, the eye). — SYNON.: *Lippitudo arida*, Cels. vi. 6, 29; *Xerosis Conjunctivæ.* This term signifies a dry ophthalmia, or chronic inflammation of the conjunctiva without much (if any) watering or discharge. The conjunctiva is thick, dull, opaque, and often skin-like. In severe cases it is shrunken, and the oculo-palpebral folds may be obliterated. The epithelium of the cornea may also be involved. The morbid changes may be the result of injury, especially burns; or it may follow trachoma, diphtheria, pemphigus, and other severe forms of conjunctivitis; or it may be due to insufficient covering of the eye in the various forms of lagophthalmia. A peculiar form of xerosis conjunctivæ occurs in association with night-blindness (*see* NYCTALOPIA). On the ocular conjunctivæ are dry, scaly-looking patches, which by gentle friction of the lids may be worked into a fine foam which abounds in bacilli.

J. TWEEDY.

XEROSIS CONJUNCTIVÆ. — *See* XEROPHTHALMIA.

Y

YAWNING (A.-S. *gánian*).—SYNON.: Fr. *Bâillement*; Ger. *Gähnen.*—Yawning is one of the physiological expressions of fatigue. It consists, when fully developed, of the following phenomena: 1. A deep inspiration, with elevation of the uvula and palate. 2. A forcible spasmodic depression of the lower jaw. 3. A flow of tears. 4. A clicking sound in both ears. 5. A tendency (sometimes irresistible) to stretch the limbs, especially the arms. 6. An expiration, often accompanied by a sound, the character of which has probably given the name to the act.

ÆTIOLOGY AND PATHOLOGY.—This strange and complicated act suggests many reflections. Why, when we are tired, should we take a deep breath? It may be that the need of oxygen experienced by the fatigued tissues, laden with waste products, prompts the instinctive and forcible descent of the diaphragm; but, on the other hand, the facts that yawning is common when we are merely *ennuyé* and not genuinely fatigued, and that it is decidedly infectious, are both unaccountable on such a theory. Why should the lower jaw be spasmodically depressed when we are fatigued? The elevators of the lower jaw are the temporal, masseter, and internal pterygoid muscles, and it is probable that the external pterygoid (whose main functions it is to move the jaw forward) has also some share in keeping the teeth in contact. These muscles are constantly in action, having to support the jaw against the force of gravity; and it is not surprising that, as in other cases of prolonged muscular action, they should be prone to evince fatigue by failure of function. Were it not for the fact that this work of supporting the jaw is divided amongst eight muscles (four on either side), it is probable that the jaw would fall more often than it does. When one set of muscles is fatigued, it is quite in accordance with experience that their antagonists should take on a spasmodic action, and we may fairly look upon the spasm of the depressors of the jaw, when the elevators are fatigued, as the physiological expression of an occasional pathological phenomenon. These considerations again do not apply to those instances of infectious (emotional) yawning, in which we are impelled to imitate what we see in others.

A fact of considerable interest in connexion with yawning is the great extent to which its phenomena are limited to the area of the fifth nerve. The four muscles mentioned above, as concerned in the negative phase of yawning, are all supplied by the fifth; and the anterior belly of the digastric and the mylo-hyoid muscles, which are connected with its positive phase, are also supplied by the fifth. The flow of tears and the 'click' in the ears, which is probably due to a contraction of the tensor tympani, are referable to the influence of the same nerve. The tensor palati is likewise in action; so that we may say that every muscle supplied by the fifth is concerned in yawning. Possibly yawning may be regarded as a reflex phenomenon, of which the most ordinary stimulus is the fatigued condition of the elevators of the lower jaw. The reflex effects are largely manifested in the area of the fifth nerve, but they clearly spread beyond it, and produce contraction of the diaphragm, palatal muscles, depressors of the hyoid bone and larynx, and sometimes of the muscles of the body generally, but mainly of the extensors. That the contraction of the body muscles at least is a purely reflex phenomenon, may be gathered from the interesting fact which has been often observed in cases of hemiplegia, namely, that when a hemiplegic arm is entirely beyond the control of the will, and its flexor muscles are contracted, this contracted helpless hand will often open during yawning, the stimulus having reached the extensors of the fingers, not through the ordinary path of the will, but through the spinal cord by a reflex action travelling along some other path of nervous energy.

In these days when so much is heard of 'hypnotism' and 'suggestion' it is perhaps profitable to bear in mind the common act of yawning, which when performed in public not only compels the spectator to perform a similar act, but definitely begets in him that mental condition of fatigue and *ennui* which is almost inseparable from the physical condition.

Treatment.—Yawning is generally only a passing phenomenon, which is removed by rest. An undue tendency to yawn may indicate that the body is too easily fatigued; and then it may be necessary to inquire whether the demands upon it (mental, physical, or sexual) are too great. These may have to be removed or avoided. At the same time the bodily health should be carefully attended to. Iron tonics may be given; the foul atmosphere of crowded assemblies should be forbidden; the diet should be nutritious and digestible; and the amount of alcohol should be carefully restricted to that physiological minimum which may be necessary to aid digestion. G. V. Poore.

YAWS.—*See* Frambœsia.

YELLOW FEVER. — Synon.: Fr. *Fièvre Jaune*; Ger. *Gelbes Fieber*.

Definition. — A pestilential contagious fever of a continuous and special type; originally developed in tropical and insular America; occurring only in regions between 45° N. and 35° S. lat.; and dependent for its origin and spread upon a temperature not lower than 70° F. Yellow fever presents two well-defined stages. The first extends from 36 to 150 hours, according to the severity of the disease, and is marked by rapid circulation and elevated temperature. The second is characterised by depression of the nervous and muscular powers and of the circulation, with slow and often intermittent pulse; jaundice; suppression of urine, albuminuria, and desquamation of the renal epithelium; diminution of the fibrin of the blood, capillary congestion, passive hæmorrhages from the mucous surfaces, and black vomit; fatty degeneration of the heart and liver; and convulsions, delirium, and coma. The fever is not dependent for its origin or propagation on those causes and conditions which generate malarial paroxysmal fever, from which it differs essentially in symptoms and pathology. As a general rule it occurs but once during life.

History.—The origin of the American plague, or yellow fever, is involved in doubt, in consequence of the prevalence in regions in which it occurs, both amongst natives and foreigners, of severe forms of malarial fever, often attended with jaundice, passive hæmorrhages, and black vomit. In the eleventh century a disease closely resembling yellow fever, known as the Matlazahuutl, made great ravages amongst the Mexicans, but it was peculiar to the aborigines, never attacking white people; whilst, on the contrary, Mexican Indians seldom suffer from yellow fever. According to authors, the first trace of yellow fever was observed at the end of the fifteenth or beginning of the sixteenth century, at San Domingo and Porto Rico; and Columbus, landing at the former place in 1493, lost the greater number of his men, within a year after their arrival, from a disease described as being 'yellow as saffron or gold.' From 1544 to 1635, when it appeared at Guadeloupe, there is no record of any outbreak, but thenceforward it occurred at irregular intervals. In the seventeenth century it spread along the east coast of America, as far as 8° S. lat. and 42° N. lat., appearing for the first time in the United States at Boston in 1693. In the eighteenth century it appeared on the west coast of South America, and extended even to Europe and Madagascar; the great commercial and military activity of this time doubtless favouring its spread, and increasing the frequency of the epidemics, eighteen being recorded as having occurred in San Domingo within the century. Early in 1700 it reached New York. At the beginning of the present century it reached 47° N. lat. in America, and also prevailed in the Canary Islands, in Leghorn, and in the maritime cities of Spain and Portugal. In 1853, 1867, 1873, and 1878, it spread to a large number of cities, towns, and villages in the interior of the American continent, being transported by railroads and ships. During this century it appears to have relinquished its hold upon the northern cities of the Atlantic coasts, and has been concentrated chiefly along the southern borders of the Atlantic and Gulf coasts. Yellow fever has prevailed almost annually as an endemic at Havana from April to December; and from time immemorial it has been endemic at Vera Cruz.

Geographical Distribution.—At an early day it was established that yellow fever is emphatically the disease of strangers in the warm, moist climates of insular and tropical America. It is endemic in the West Indies, and is rarely, if ever, absent, the seasons of the year having but little influence in eradicating it, though the disease is most fatal from May to August. On the other hand, the history of the settlements along the shores of the Gulf of Mexico and Atlantic Ocean has demonstrated that in the more temperate regions it is a disease of occasional occurrence, and not in the strict sense of the term endemic. Since the disease is dependent in a great measure upon an elevated temperature, its occurrence is limited to tropical and subtropical regions, or to countries having a tropical climate, or a summer of sufficient length and heat. Within these prescribed limits the exciting cause seems to exist, but still the fever has seldom, if ever, shown itself except in maritime regions, elevated but a few feet above the sea. From Brazil to Vera Cruz in one direction, and from Barbadoes to Tampico in another, the exciting causes are in constant though unequal force, depending on differences of season, locality, and constitution. On the Atlantic coast it has extended as far north as Boston, Massachusetts, and Portland, Maine; while in the Mississippi valley it has three times appeared as high as Memphis, Tennessee, in latitude 35° N. In an eastern direction, but within the same parallels, it has extended to Cadiz, Xeres, Carthagena, Malaga, Alicant, Seville, Barcelona, and other cities on the coast and in the interior of Spain. It has prevailed several times at Gibraltar, once at Rochefort, twice at Lisbon, and once at Leghorn. It prevailed at Monte Video, lat. 34° 54′ S. in 1857 and 1872; in Buenos Ayres in 1858 and 1871; once at Panama and Callao, and at Lima and Cuzco in Peru, in 1854 and 1856. In America it reaches from lat. 36° S. to 45° N. on the Atlantic coast, and to 35° N. in the Mississippi valley. On the Pacific coast it extends from 15° S. to 9° N. Its longitudinal limits in the same country are 60° to 97° W. In the eastern hemisphere it occurs within the limits of 42° N. and 8° S. It is said not to appear in the East Indies or China.

Perpendicular distribution.—The older statements, that yellow fever never extended beyond the height of 2,500 ft., are shown to be incorrect; for it has prevailed in the elevated tablelands of Caracas, 3,000 ft. above the sea-level, on more than one occasion; and in 1854 and 1856 it committed fearful ravages in Cuzco at an elevation of 11,378 ft., and even in other places in the Andes at 14,000 ft. Great variety, however, exists in this respect, for at Xalapa, in Mexico, in the same parallel with Vera Cruz, 4,330 ft. above the sea, it has never prevailed as an epidemic; and the hills in Jamaica and San Domingo are free from the pestilence which rages in the low lands.

Ætiology and Pathology.—*Relation to population.*—A certain degree of density of population appears to be essential to the production of yellow fever, which never originates in country districts, but is a disease of crowded cities on the shores of the ocean or large rivers, and of ships. Its origin and spread are favoured by the congregation of persons born in a cold climate; and where developed in strangers who have landed in a port in which it is not prevailing, it appears to be referable to the action of endemic causes upon highly susceptible individuals.

Relation to temperature.—However violent the disease may be at any place, yellow fever is arrested from the day on which the earth is frozen, and such localities may then be visited with impunity by strangers. The singular occurrence of the disease at the high elevations in the Andes above mentioned, appears to be due to the fact that, whilst in those regions the night and morning are excessively cold, intense heat prevails in the afternoon.

Incubation.—The period of incubation appears to vary in different epidemics, and in different individuals in the same epidemic, and may extend from twenty-four hours to weeks or even months. In this respect yellow fever resembles diseases of malarial origin, and differs from the well-defined contagious maladies. Whilst in some a few hours' exposure to an infected atmosphere is sufficient to determine the disease, others may remain unaffected until the end of an epidemic, or even through several epidemics. Cases have been known to occur in the winter, weeks after it appeared that the disease was entirely checked, the poison being looked upon as lying dormant in the system. Like many other contagious diseases, it may be communicated to the fœtus, and this is supposed to partially explain the immunity enjoyed by the natives of localities in which it is endemic.

Essential cause.—The various opinions on this point fall under three heads: 1. That yellow fever is a disease induced essentially and solely by contagion. 2. That it is essentially of endemic origin. 3. That being of endemic origin, it afterwards becomes contagious.

The idea has been extensively entertained that intermittent, remittent, and pernicious paroxysmal malarial fevers, as well as yellow fever, assume more or less, according to circumstances, the type of each other, and are essentially the same, modified only by the intensity of the cause, and by the prevailing constitution. The marked exemption from the disease of the natives of districts where yellow fever is endemic, with their liability to mild intermittent and remittent attacks, is regarded as supporting this view.

The following facts have been cited to sustain the opinion that yellow fever arises from miasmata. 1. It always appears simultaneously with bilious remittent. 2. A high range of temperature is essential to the generation of its cause. 3. Its first appearance is almost always in the lowest and most filthy parts of towns; and in localities favourable to the production of miasmata. 4. The supervention of storms, heavy rains, or cold weather puts an immediate check to its progress.

With some writers it is still even a disputed question whether certain fevers which have, or are supposed to have, their source in vegetable miasmata, or in effluvia from marshes, or from infusoria or fungi, developed and propagated under certain combinations of heat, moisture, and putrefying vegetable and animal matters, are subsequently spread by contagion; whilst other writers contend that within the tropics yellow fever may at any time, under certain conditions of moisture and temperature, arise *de novo*, in the impure atmosphere of the crowded and filthy ship or city. Others, again, as strenuously uphold the doctrine that yellow fever is a specific, contagious, pestilential disease, which, like small-pox or measles, may be transferred and communicated from one ship or city to others, thus following the great avenues of commerce. A third class adopt and advocate a doctrine which embraces the main features of both propositions. Some who hold that yellow fever may be engendered *de novo* in the holds or atmosphere of ships navigating in the warm, moist, tropical regions, have coupled with this view the doctrine that if this poisoned atmosphere be allowed to escape at the wharves of cities situated beyond the yellow-fever zone, those only who come within the sphere of its influence will be affected, and its subsequent spread will depend upon conditions of filth and crowding of such localities, the disease never spreading endemically, but falling harmless among the inhabitants of a salubrious locality. According to this view, the development of this malignant fever requires the conjoint operation of both local and general causes, constituting an endemico-epidemic which is insusceptible of propagation by specific contagion; and in the summer atmosphere of a city lying beyond the yellow-fever zone there must exist some peculiar combination of circumstances, or some peculiar agency, favourable to its development. In these cases it is affirmed that there is generally found an infected district, which slowly and regularly extends its boundaries, rendering all who come within its limits subject to this form of fever.

It has been said that the experience of several centuries leads to the view that the cause of yellow fever is perennially present in the tropical and subtropical cities of America; that it maintains the same relation towards the human system as the other malarial emanations of swamps and lowlands; and that it is liable to be developed at any time, in different degrees of intensity, by the combined operation of heat and other agents. Amongst the most striking circumstances in the ætiology of yellow fever are the marked geographical boundaries within which it is confined, and the circumscribed localities in which it prevails; its more frequent prevalence in the western than in the eastern hemisphere; its almost universal limitation to commercial seaports elevated but a few feet above the level of the sea, although it occasionally spreads to towns and cities in the neighbourhood of the latter, situated in the interior of the country, on the banks of navigable rivers; and the fact that it is very frequently circumscribed within certain limited and well-defined portions of the locality or city in which it prevails. To these may be added the vastly greater susceptibility of strangers over the natives of regions in which the disease is endemic, although this susceptibility is liable to diminution by residence in the proscribed regions.

Possibly the specific infectious agent in yellow fever is a living micro-organism which, under favourable meteorological conditions, multiplies external to the human body in insanitary localities, when it finds a suitable pabulum for its growth. But the correctness of this inference has not as yet been established by an experimental demonstration, and we are still ignorant of the morphological and biological characters of the yellow-fever germ.

Anatomical Characters. — In cases of death from yellow fever the features are frequently bloated; the skin of the face and upper part of the trunk is of a golden-yellow colour; whilst dependent parts present a mottled purple, and a yellow ecchymosed appearance. Considerable quantities of dark fluid blood escape on section of the muscles, becoming bright scarlet on exposure. Putrefactive changes set in early, commencing sometimes even before death.

The *nervous system* presents no characteristic appearances beyond general congestion. Urea, bile, and leucin have been obtained, by analysis, from the brain.

The *heart* is in a condition of acute fatty degeneration, of a pale yellow or brownish-yellow colour. This degeneration is more extensive and more rapid than in any other disease. The cavities are usually filled with dark fluid blood, which contains an excess of urea, ammonia, and extractives, with a great diminution of fibrin. No such appearances are found in the heart in malarial fever.

The *lungs* present extreme congestion of dependent portions, and sometimes circumscribed hæmorrhages into the pulmonary tissue.

The mucous membrane of the *stomach* is frequently intensely congested, softened, and eroded, often containing large quantities of black vomit of an alkaline reaction, from the presence of ammonia, resulting from *ante-mortem* decomposition of the urea. Microscopically the vomit is seen to contain red blood-corpuscles, gastric epithelial cells, dark masses of hæmatin, and sometimes vibriones and other organisms.

The *intestines*, as a general rule, are dark-coloured and distended with gas, sometimes containing large quantities of dark altered blood, of an alkaline reaction. Bile is always absent from the intestinal contents. Intussusception of the bowels is by no means infrequent.

The *liver* is yellow and bloodless, and the stroma and secreting cells are infiltrated with fat, though the organ is firmer than is the case in ordinary fatty degeneration. None of the pigment deposited in the portal capillary system in malarial fevers is found in yellow fever. When yellow fever has been preceded by or engrafted on malarial fever, the liver presents the appearances of both these diseases, and hence some confusion has occurred in the recognition of the normal pathological appearances proper to each. The golden-yellow colour of the yellow-fever liver can be extracted both by alcohol and water. A similar decoction of the malarial liver is of a brownish-yellow colour; in the latter case also the organ is softer, contains more blood, and is readily dissolved by liquor potassæ, forming a solution of the appearance of venous blood, which is not the case in yellow fever. Large quantities of urea and fat, as well as glycogen and glucose, may be obtained from the yellow-fever liver, whilst, as a general rule, grape-sugar is absent from the malarial form.

As a general rule the *gall-bladder* is contracted and flaccid, and contains but very little bile; but sometimes it is distended with dark grumous blood, and occasionally an albuminous mucoid liquid, without a trace of bile. In malarial fever, on the contrary, the gall-bladder is usually full of dark greenish-black bile.

The *spleen* is but slightly enlarged as a rule, and is frequently normal in size and appearance, internally as well as outside.

The *kidneys* are of a brownish-yellow colour, and loaded with fat. The Malpighian corpuscles and tubuli uriniferi are filled with granular albuminoid and fatty matter, detached epithelial cells, and oil-globules.

The *urinary bladder* is almost always empty; the little urine that it may contain is of a light yellow colour, free from crystalline deposit, and loaded with albumin.

SYMPTOMS.—*Invasion.*—The symptoms of yellow fever at this stage are uncertain and ill-defined. Attacking a community, as this disease does, without discrimination of age, sex, or state of health, those only being exempt who have already suffered from the malady, it of necessity offers the greatest variety of manifestations. The onset, as occurring suddenly in apparent health, is marked by intense headache, rigors, pain in the limbs and back, rapid rise of temperature, eyes glistening and suffused, congested countenance, intense thirst, anorexia, uneasiness at the epigastrium, nausea, and vomiting.

Stage of chill, or primary depression.—Here, also, the symptoms are not uniform. In some cases, and even in those of the greatest violence, chills are entirely absent, or amount only to a sense of coldness. In others they are deep, penetrating, and stupefying, or alternate with flushes of heat and crawling sensations; or the constriction of peripheral vessels may be extreme, causing a shrivelled appearance of the skin. In some cases, again, the disease is ushered in by giddiness, and in others with convulsions. Neither the presence nor absence of chills, therefore, can be regarded as characteristic. The chills, when they do occur, differ from those occurring in true malarial fever, and rather resemble those which may take place at the onset of such diseases as small-pox or pneumonia.

Stage of reaction.—The stage of active febrile excitement follows the chills, or the premonitory symptoms of uneasiness, prostration, and languor, with severe pain in the head and limbs, in the form of a rapid elevation of temperature. This ranges in the first day of the disease, according to its severity, from 102° to 110° F. in the axilla; and it is probable that the internal organs attain in some cases a temperature of 112°. As a general rule, from the third to the fifth day it falls to the normal standard, and even below it; in some fatal cases it rises again towards the end, rarely, however, exceeding 104° F., and never attaining the high degree reached at first. The supervention of any inflammatory condition, or the occurrence of an abscess, will also cause a rise of temperature, with slight evening exacerbations; but as a rule the secondary elevation thus caused never equals the maximum of the stage of active febrile excitement. When malarial paroxysmal fever is engrafted upon yellow fever, in its later stages, or during the period of convalescence, the temperature during the hot stage may even exceed the maximum of that of yellow fever, but it will be characterised by sudden periodic depressions and elevations recurring at definite intervals. The pulse, when reaction has set in, is rapid, strong, tense, and full, though occasionally feeble and compressible. The increase of the frequency of the pulse does not, however, as a general rule, continue to correspond with the elevation of the temperature; and in many cases the remarkable phenomenon is witnessed of the pulse progressively decreasing in frequency, and even descending below the normal standard, while the temperature is maintained at an elevated degree. This singular circumstance is of great diagnostic value, as serving to distinguish yellow fever from other diseases, and especially from malarial paroxysmal fever, and also as indicating the presence in the blood of a poison possessing a specially depressing influence on the heart. On the other hand, the pulse may increase in frequency, but diminish in force, near the fatal issue, with a fall in temperature, particularly if there have occurred free hæmorrhage from the stomach.

The stage of febrile excitement is not of fixed duration, and may in some of the gravest cases appear to be comparatively mild and unimportant. At the same time the pains may be so slight, and there may be such an absence of delirium and but small failure of strength, that both patient and physician may be deceived, and yet the former may die without taking to his bed. In most of these so-called 'walking cases,' the kidneys have been involved from the inception of the disease, and complete suppression of the urine has supervened before death. This latter symptom is almost invariably fatal, and is a chief cause of the hæmorrhages from the stomach and bowels, and also of the marked blood changes, leading to severe nervous disturbances, and frequently to sudden death. There is no doubt but that the fever-poison directly interferes with the nutrition of the gastro-intestinal mucous membrane, liver, and kidneys, loading thereby the already vitiated blood with the abnormal products of their disintegration, whilst the circulation of the impure blood necessarily affects all the tissues of the body, and intensifies the morbid changes in those organs primarily attacked by the specific poison. The action of the poison of yellow fever, during the stage of acute febrile excitement, is manifested not only by intense pain in the head and back, and the florid congestion of the eyes and skin, the anorexia and nausea, the pyrexia and increased frequency of pulse, but also by the albuminuria, which is rarely entirely absent in severe cases, and may make its appearance on the first day of the febrile state.

The congestion, so marked upon the conjunctiva and skin, extends also to the internal organs, and is well seen in the injected nares, crimson lips, scarlet tip and edges of the tongue. As a general rule, in the stage of febrile excitement, the tongue is pointed, red at the tip and edges, and coated with thick white and yellow fur in the centre and over the roots. After the febrile excitement has continued for over three days, in some cases the tongue may present a corrugated, cracked, and bloody appearance. We never observe in specific yellow fever the broad tongue with indented edges, which often characterises the prolonged action of the malarial or paludal poison. The gums are red, spongy, and often bleed upon pressure, and the fauces brilliantly congested. The fact that mere examination of the throat and depression of the tongue are sufficient to cause nausea and retching, is an important diagnostic sign.

Stage of depression and exhaustion.—In cases which terminate favourably, the deleterious substances generated during the stage of febrile excitement are gradually eliminated, and the organs especially affected by the poison resume their healthy actions. In those cases which end fatally at this stage, the issue appears to be mainly determined by heart-failure from acute fatty degeneration, as well as the profound blood-changes induced by the specific poison, and the retention of the secretions of the liver and kidneys, the functions of which are arrested. There appear to be no just grounds for the subdivision of this fourth stage, in accordance with the presence or absence of hæmorrhage, coma, jaundice, uræmic poisoning and convulsions, for these are simply effects and aggravations of the preceding symptoms, and must be regarded as the maximum phenomena of the stage. Neither is this stage to be regarded as similar to, or identical with, the intermission or remission of malarial fever, or as an abortive repetition of the febrile stage, in which the disease ends from adynamic incompetency to carry out the phenomena.

The black vomit.—The ejection of altered blood from the stomach—black vomit—during the period of depression, although not absolutely characteristic of yellow fever, is still of such frequent occurrence as to demand special consideration, both of its nature and origin. The character of the matters vomited varies in different stages of the disease, as also with the degree of its severity. Whilst yellow fever is characterised, in common with several other diseased states, by an irritation of the gastric mucous membrane, the peculiar nature of the vomited matters does not rest entirely upon this irritation and congestion, but is influenced to a greater or less extent by the changes in the blood, liver, kidneys, and nervous system. The vomiting also may be regarded as, to a certain extent, salutary, and as an effort for the elimination of excrementitious materials from the blood. For in some cases distinct improvement follows the vomiting, as seen in the abatement of the pyrexia, and the cleaner condition of the tongue; and it would almost seem that, were it not for the profound changes in the blood and organs lying at the back of this almost universally fatal symptom, recovery might start from its occurrence. The first ejections generally consist of the ordinary gastric secretions, followed by a mucoid fluid, which is frequently at first tinged with bile, sometimes of an acid, sometimes of an alkaline reaction. The acidity is not due to the presence of any peculiar acid, but to hydrochloric or lactic acid, and is mainly determined in intensity by the nature of the ingesta. After the first vomiting the stomach may remain tolerably quiet until the subsidence of the fever on the third, fourth, or fifth day, when, without any premonitory symptoms of nausea, the stomach, on any trifling provocation, may eject a quantity of clear, pale, almost limpid, and slightly acid, opalescent fluid. At this period the disease may terminate, as if this excretion were similar to the perspiration of intermittent fever. If the vomiting continue, it becomes first streaked with dark flocculi of altered blood, and acquires an alkaline reaction, due to carbonate of ammonium, arising from the decomposition of the urea, which is eliminated from the gastric mucous membrane. The black vomit varies in specific gravity from near that of distilled water to that of blood; and it consists of the secretion of the mucous membrane, mixed with food, altered blood, epithelial cells, and excrementitious products, such as urea and carbonate of ammonium.

The urine.—The reaction of the urine is invariably acid, even in the gravest cases. As a rule, the specific gravity ranges from 1,009 to 1,028. In those specimens of the highest density the increase appeared to be due to the amount of albumen. During the early stages of the disease, the urine is normal in colour, clearness, and quantity; as the disease proceeds, it becomes of a deep yellow colour, from the admixture of bile; and on the fourth or fifth day appears turbid, from the presence of renal epithelial cells, tube-casts, and yellow granular albuminoid matter. The colour may deepen to orange-red, or even to reddish-brown; and the urine sometimes presents an oily appearance. The quantity may be much diminished, up to complete suppression. As a general rule, the amount is diminished in the active stages of the fever. If the case advance favourably the urine is copious, and the colour progressively increases in depth even to almost black. In grave cases it is much less abundant, and at the same time of a much lighter colour. Albumin is an almost invariable constituent, and may appear as early as the first day of the disease, but most generally from the second to the fifth. When convalescence is protracted, the albuminuria may continue long after all symptoms but debility have left the patient. When precipitated by heat or nitric acid, the albumin appears of a golden yellow or light brownish colour. As much as one ounce of dried albumin has been excreted in twenty-four hours, representing the albumin of nearly one pound of blood. Associated with the albumin are renal epithelial cells, and casts of tubules, but the albuminuria must not be wholly referred to an acute desquamation of the excretory cells, nor to mere capillary congestion, being equally due to chemical changes effected by the poison of yellow fever in the albumin and fibrin of the blood. The albumin appears in large amount in the urine, in cases where there is no apparent failure in the excretory action of the kidneys, and in which the urine is abundant, and laden with urea as well as bile. The presence in the urine of red corpuscles and the colouring-matter of the blood is not so characteristic in this disease as in the so-called malarial hæmaturia, where renal casts and epithelium may occur in considerable amount, but with only sufficient albumin to correspond to the exuded blood; whilst in yellow fever, when blood does appear in the urine, the amount of albumin is much greater than could thereby be accounted for. In the former disease, also, the urinary casts contain red corpuscles, and are of a brownish colour, in place of the golden-yellow tint which these oil-laden bodies present in yellow fever.

Throughout the disease, when there is no suppression, the amount of urea is much increased, reaching as much as a thousand grains *per diem*. There is a similar increase in the phosphoric and sulphuric acids, up to as much as fifty and sixty grains respectively.

Pathology.—The various manifestations of yellow fever, as the intense capillary congestion, cardiac depression, delirium, coma, and convulsions, vomiting, hæmorrhage, urinary suppression, and jaundice, may all be referred to the action of the specific poison, and should not be erected into distinct types of disease, however prominent any one of these symptoms may be, and however much cases may differ from each other. The action of the yellow-fever poison is the same in all cases, whether mild or severe; the progress and termination, and the manifestation of the various symptoms, depending on the degree of action of the poison, the condition of the system at the time of its introduction, the peculiarities of constitution, the various agencies to which the patient is subjected during the course of the disease, and the supervention of other maladies.

Yellow fever, according to this view, partakes of the nature of a continued pestilential fever, presenting two well-defined stages. The first is characterised by active chemical change in the blood and organs, attended with elevation of temperature, which may constitute the entire malady, and prove fatal in a manner similar to other acute specific fevers. The second, or stage of depression, results from the action of the poison, and the blood-changes induced by the suppressed functions of certain organs.

From a consideration of the foregoing symptoms, it is manifest that the blood must have undergone profound changes, which seem to consist chiefly of the following:—

1. Such an alteration of the chemico-physical properties of the fibrin and albumin as leads to the transudation of the latter, through the excretory structures of the kidney.

2. Various degrees of diminution of the fibrin, in some cases amounting to almost entire disappearance; and this apparently due more to the direct action of the specific poison, than to the retained urea, bile-acids, or other substances. As a result, the blood coagulates imperfectly; and the clot is soft and bulky, exuding but little serum, and often breaking down into a grumous fluid on standing.

3. Whilst the red blood-corpuscles are not specially diminished, they are much altered in appearance.

4. Increase of fatty and extractive matters.

5. Accumulation of the biliary constituents, as shown by the golden-yellow colour of the serum.

6. Accumulation of the urinary constituents, especially the urea, carbonate of ammonium, chloride of sodium, and phosphoric and sulphuric acids. The alkaline reaction of the blood during life rapidly changes after death to acid.

7. Rapid dissolution of the red blood-corpuscles, with corresponding diminution of their oxygen-carrying power.

8. Rapid putrefaction after its abstraction from the body.

The various causes of black vomit may be thus summarised: 1. The irritation and structural alteration of the gastric mucous membrane, which is a part of the general tissue-degradation, consisting of granular and fatty degeneration of the secreting cells, and of the walls of the smaller blood-vessels and capillaries, as well as the general congestion of the stomach. 2. The changes in the blood, especially the marked diminution of the fibrin. 3. The suppression of the action of the kidneys, and the retention in the blood of urea and similar bodies. It may be noted that black vomit rarely occurs in those cases where the kidneys act continuously and freely. 4. The direct irritation of the urea and its derivatives, which are eliminated vicariously from the gastro-intestinal mucous membrane. 5. The irritant, nauseating effects of the bile retained in the blood.

In yellow fever, acute atrophy of the liver, and acute phosphorus-poisoning—diseased states which have many symptoms and pathological lesions in common—it would seem that the oxidation of albuminoids is not so complete as in health, and besides the formation of leucin, tyrosin, and other similar bodies, a large amount of fat is produced, which may extensively infiltrate the tissues. It is clear that one effect of suppression of urine is to determine the retention in the blood of a large excess of urea. This may in part be eliminated by the gastro-intestinal mucous membrane, and the black vomit may be intensely alkaline from carbonate of ammonium derived from this substance; and it is further evident that in many cases of yellow fever the fatal issue is determined chiefly by the retention in the blood of the constituents of the urine. To the same cause must be attributed, to a great extent, the nervous irritation, delirium, convulsions, and coma which characterise the stage of depression. Certain of the blood-changes may be also referred to this cause.

Duration.—The several stages of yellow fever which have been described are not uniform in their duration, and there may be a marked diversity in the manifestation of the symptoms in individual cases, some presenting apparently but the stage of febrile excitement, whilst others, overwhelmed as it were by the poison, at once pass into a condition of hopeless prostration. In mild cases, especially in children, the disease may be so slight as barely to attract attention, and convalescence may be established in two or three days. The stage of febrile excitement may continue from two to six days, rarely beyond three or four, and the patient may pass almost imperceptibly into convalescence during the stage of depression. The severest cases may prove fatal in two or three days, with an axillary temperature of 110° F.; or later from hæmorrhage, urinary suppression, general prostration, or an adynamic state, accompanied with parotid abscess, revival of old complaints, or the supervention of some other disease, such as malarial fever. The fourth stage may be of long duration, extending over weeks and even months. It is, however, true that convalescence is usually comparatively rapid, and in striking contrast to the tedious recovery from malarial fever. In some cases vomiting may be the prominent symptom; in others hæmorrhage from the stomach and bowels, or from the gums, eyes, and ears; in others, again, the cerebral symptoms may be most marked.

Terminations and Mortality.—In fatal cases death may be referred to a variety of causes, namely: 1. The direct action of the fever-poison upon the blood and nervous system. 2. The disturbance or suppression of function of certain organs, as the kidneys and liver. 3. Syncope from cardiac degeneration. 4. Profuse hæmorrhages from the stomach and bowels. 5. Blood-poisoning from absorption of putrid black vomit in the stomach. 6. The formation of abscesses with sequential pyæmia.

The mortality occasioned by yellow fever appears to be as great as that caused by any known epidemic or endemic disease, and varies in different localities and epidemics from 10 to 70 per cent. of those attacked.

Prognosis.—Continuous observations of the temperature should be made, as by that means prognosis and treatment may best be regulated. If the axilla temperature rise in the first stage above 105°, the patient is in imminent danger; and if it reach from 109° to 110° death is almost inevitable. Cases, however, have recovered in which the temperature has reached the latter point. When the temperature rapidly rises to 106° and upwards, death sometimes occurs suddenly, and apparently solely from the effects of the high temperature upon the blood, heart, and nervous system, as in sunstroke.

Treatment. — 1. *Prophylactic.* — Experience has established the possibility of excluding yellow fever from localities in which it has prevailed as an epidemic, subsequent to introduction from other regions, by means of an absolutely strict quarantine. But hitherto it has been almost impossible to arrive at any definite conclusions as to the value of quarantine in those regions in which the disease is endemic and indigenous.

Much difference of opinion has existed as to the value of disinfectants, such as chlorine, carbolic acid, and sulphurous acid. In arresting the spread of the fever it is very doubtful whether much of the benefit that has been attributed to them is not rather to be ascribed to other causes; and, in estimating the value of any such sanitary measures, the following facts in the history of yellow fever should be considered:—

(*a*) Yellow fever may prevail in one or more cities, and at the same time be entirely absent from other cities in the same zone, and subjected to very nearly the same hygienic conditions. The mere absence of yellow fever from a particular city, whilst it is prevailing elsewhere, proves nothing as to the mere sanitary condition and measures of the city enjoying the immunity.

(*b*) One of the most essential elements for the origin and spread of yellow fever within and immediately around its recognised geographical limits, is the influx of strangers and immigrants, or an unacclimatised population.

(*c*) It is not provable that a widespread epidemic would ever arise in a city within the recognised zone in which the vast proportion of the inhabitants are acclimatised, and have been subjected to the action of the specific poison.

(*d*) Yellow fever has been entirely absent from many cities, where serious epidemics have occurred, during long series of years; and at other times has prevailed to a very limited extent, and with but slight mortality, when no disinfectants have been used.

2. *Curative.*—Yellow fever is a 'self-limited' disease, and cannot be arrested by drugs. Every case should be regarded as serious, however slight the symptoms may appear; and, on account of the structural alterations in the blood and organs, the closest medical attendance and most careful nursing are required. Since so many of the symptoms are due to arrest of the functions of the skin and kidneys, efforts should be directed to promote the activity of these organs during the progress of the disease. Stimulant diuretics should, as a rule, be avoided; but benefit often follows the free use of hot mustard foot-baths, vapour baths, and sometimes warm baths. Diaphoresis and diuresis may be further promoted by large draughts of lemonade, decoctions of orange-leaf and sage tea, and water charged with carbonic acid. Absolute rest in the recumbent posture must be maintained as far as possible. The necessity for this is especially indicated by the cardiac weakness, fatal results having followed rising from bed and walking during the period of calm.

The maintenance of free ventilation, and the avoidance at the same time of sudden changes of temperature, by proper coverings, are essential. Experience shows that many fatal cases from urinary suppression have followed sudden changes and falls of temperature. Each case of yellow fever should have at least 2,000 cubic feet of space; and hospitals, where practicable, should be constructed on elevated situations. All discharges should be immediately removed from the sick-room; the bedding frequently changed; and the soiled clothing boiled, or baked at a temperature of not less than 230° F.

The practice of covering patients with heavy blankets, and at the same time giving large quantities of hot drinks, with the object of inducing profuse sweating, frequently appears to be injurious, not only from the debilitating effect, but also from the greater susceptibility of the skin, and the increased tendency to renal congestion thereby induced.

The diet should be light and nutritious. Beef-tea, chicken-tea, corn-flour and rice gruel, barley water, iced milk, and milk and lime-water are the best forms of nourishment, and should be continued at regular intervals throughout the active stages of the disease. Solid food and even bread should be avoided.

In many cases the preceding measures, accompanied by absolute rest in bed, and the careful and continuous attention of an experienced nurse, will be all that is required.

Alcoholic stimulants should be used with caution. They have proved beneficial in cases attended with great prostration, champagne appearing to be the best form.

The treatment for hyperpyrexia consists in the giving of such cardiac sedatives as aconite, veratrum viride, or gelsemium; the injection of large quantities of ice-cold water into the rectum; sponging the surface with cold water, or with water, acetic acid, and alcohol; and blood-letting. It appears also that an active purgative, such as calomel (gr. x.) or castor oil, followed immediately by one or two full doses (gr. x.) of quinine in the first twenty-four hours of the fever, may reduce the temperature.

Efficient but gentle purgation in the early part of the first stage may be beneficial. Mercurials should not be given later than the second day for an adult; eight to twelve grains of calomel or blue pill, or an ordinary dose of castor oil, will be sufficient. Purgatives, as a general rule, should not be administered in the stage of depression. An emetic may be useful at the very beginning, if the stomach be loaded. Local blood-letting, whilst of occasional benefit for the relief of congestion in the first stage, is most injurious later. Dry-cuppings and sinapisms are usually sufficiently effective.

The internal administration of the mineral acids or the tincture of the perchloride of iron, from their supposed beneficial effects upon the jaundice and black vomit respectively, is of doubtful propriety, and sometimes directly injurious.

The value of quinine in yellow fever is not nearly so great as in paroxysmal malarial fever; and, notwithstanding statements to the contrary, the writer fails to discover any facts or cases by which the power of large doses of quinine to abort this disease can be fully and unequivocally established, though its efficacy, not only in arresting, but in warding off paroxysmal fever, is undoubted. It is rather as an antidote to the effects of the poison, than to the poison itself, that quinine is of use.

Opium, in whatever form, should be administered with great caution, from its poisonous effects when the kidney-action is arrested, but may be of advantage when sleeplessness and restlessness are prominent. Arrest of the function of the kidneys, owing to the grave alterations in their structure, is beyond relief by drugs. The tincture of ergot, which has been recommended, has often failed; but much good has been accomplished, and the function of the kidneys restored, by the injection, at regular intervals, of a pint or more of ice-cold water into the rectum.

When there is a threatening of black vomit, ice should be swallowed, and bags of the same applied to the epigastrium. Septic poisoning has been known to follow decomposition of the blood effused into the gastro-intestinal tract, and to prevent this, scruple doses of sulpho-carbolate of sodium, repeated every three or four hours, have been given with advantage.

During the period of calm, active medication, beyond what has been indicated, should be abstained from. The diet should still be of the simplest, most nutritious, and most digestible character. In this stage there is often a morbid craving for food, and in some instances relapse and death have been the result of the unrestrained indulgence of the appetite.[1]

JOSEPH JONES.

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[1] In the epidemic of yellow fever in New Orleans during 1878, when, in a population of 210,000, the deaths numbered 4,056, the writer had an extensive experience of the disease, himself treating 256 cases, of whom 18 died. The plan of treatment was based upon the preceding principles. The alimentary canal was cleared at the outset by an emetic of ipecacuanha, and a powder of 10 to 20 grains each of calomel and quinine, followed by a full dose of castor oil. The action of the skin was excited by hot mustard foot-baths and mild diaphoretics. The function of the kidneys was maintained by the regular use of cold water, by attention to the covering of the patient, and avoiding cold currents of air. Absolute rest, in all cases, in a well-ventilated room, for from eight to fourteen days, or even longer, was strictly enforced, supplemented with careful nursing night and day, and the most exact record of the progressive state of the patient. During the period of febrile excitement the patients were confined to barley water. When the initial temperature was high, 2 to 4 drops of tincture of green hellebore, or 5 to 10 drops of tincture of gelsemium, were administered every two or four hours, combined with friction with a liniment composed of from 1 to 2 drachms of the sulphate of quinine mixed with 3 fluid ounces each of soap liniment and olive oil. Ten grains of sulpho-carbolate of sodium in orange-leaf tea were given every four hours. Where the head was very hot and there was much nervous irritability, cold applications were employed. Gastric irritation was treated by sinapisms to the epigastrium, with carbonate of calcium and creasote internally. Except in cases attended with great nervous excitement, without urinary suppression, opiates and chloral were not given; but in such cases they were apparently beneficial. Cupping over the loins and bromide of potassium were used when the urine was diminished in quantity. After the subsidence of the febrile excitement, iced champagne and beef-tea were administered in small quantities, at regular intervals. In cases which assumed the 'typhoid state,' attended with tympanites, ice-cold enemas, containing small quantities of tincture of asafœtida and oil of turpentine, were found to be beneficial by reducing the temperature, stimulating the bowels to expel the flatus, and promoting the action of the kidneys. When secondary fever ensued, and presented an intermittent or remittent type, the sulphate and hydrobromide of quinine were freely used. And when the stomach would tolerate nourishment and stimulants, beef-tea, chicken-tea, beefsteak, and port wine or brandy were administered. When convalescence was prolonged, or life endangered by abscesses or

YELLOWSTONE NATIONAL PARK, in the Rocky Mountains, United States of America.—A tract of country, 65 miles long and 55 miles wide; altitude 6,000 feet. Remarkable for its thousands of mineral springs, containing principally salts of calcium and silicon, with a temperature of 160° to 200° F.; and for its fifty geysers or hot springs, throwing up columns of water 50 to 500 feet in height. Largely utilised in chronic rheumatism and gout. *See* Mineral Waters.

Z

ZINC, Poisoning by.—Synon.: Fr. *Empoisonnement par le Zinc*; Ger. *Zinkvergiftung.*

Poisoning by compounds of zinc is rare, if we except poisoning by the chloride (Sir W. Burnett's fluid), which acts as a corrosive poison, like the mineral acids (*see* Poisons). Zinc sulphate (white vitriol) is the only other salt of zinc of importance from a toxicological point of view; this salt has proved fatal in a few instances.

Anatomical Characters.—These are of the same nature as those of the mineral irritants—gastro-intestinal inflammation, ecchymoses, and softening. Ecchymoses have also been observed in the pleura.

Symptoms.—The symptoms of poisoning by zinc are similar to those produced by tartar emetic. They include an astringent, metallic, and burning taste in the mouth; early and violent vomiting; pain in the abdomen; purging; great prostration and anxiety; a small and feeble pulse; shallow respirations; cold perspirations; and collapse and exhaustion, ending in death. The intellect is unaffected.

When taken in small doses, zinc produces a chronic form of poisoning, the symptoms of which are derangement of the digestive organs, and peripheral neuritis.

Diagnosis.—In the absence of any history of the administration of zinc sulphate, the diagnosis cannot be made between this and other forms of irritant poisoning, such as by blue vitriol, except by the aid of chemical analysis.

Prognosis.—The prognosis of zinc-poisoning is generally favourable.

Treatment.—Demulcent drinks, sedatives, and alcoholic stimulants should be immediately given. The administration of a solution of the common phosphate of sodium, largely diluted, is advisable. It acts as an excellent precipitant of zinc, in the form of an insoluble phosphate. Opiate enemata may prove serviceable.

Thomas Stevenson.

carbuncles, iron and other tonics were given, together with a nutritious diet, and the local application of carbolic acid, tincture of iodine, &c. Relapses were avoided by confining the patient to bed until the heart had regained its usual vigour.

ZONA or ZOSTER (*zona*, *ζωστήρ*, a girdle).—Synon.: Shingles; Fr. *Zona*; Ger. *Zoster*; *Gürtelrose.*

This term was originally applied only to that form of herpes which runs round one half of the trunk of the body, usually in the region of the waist. Subsequently, however, the term 'zoster' crept into our dermatological literature as a generic appellation, and we read of *Zoster facialis*, *brachialis*, &c., names which philologically are evidently inaccurate. *See* Herpes.

Erasmus Wilson.

ZYMOTIC: ZYME (*ζυμάω*, I ferment; *ζύμη*, a ferment).—Synon.: Fr. *Zymotique*: *Zymase*; Ger. *Gährungsfähig*: *Gährstoff.*—The terms *zyme*, *zymine*, *zymotic*, and *zymosis* were introduced by Dr. William Farr, in a Letter to the Registrar-General in 1842, and employed by him to denote in a general way the poison (and pathological processes excited by it) of 'epidemic, endemic, and contagious diseases.' In using the word *ζύμα*, he was careful to point out that he did not consider the morbific process to be absolutely identical with the ordinary phenomena of fermentation, and that he wished the terms *zymosis*, *zymotic*, &c., to be employed in English, 'not in the sense which they have in Greek, but as general designations of the morbid processes and their exciters.' With this qualification clearly expressed, the use of the root-form *ζυμ-* has become general, not only in scientific literature, but also in the public press—almost invariably, however, in the adjectival form *zymotic*.

Fourteen years later (1856), in the *Sixteenth Annual Report of the Registrar-General*, Dr. Farr described the diseases of the zymotic class as conveniently referable to four groups. These are: 1. The *Miasmatic*, diffusible through the air or water, attended by fevers of various forms; the matter by which they are communicated is derived from the human body, as in small-pox, or from the earth (as in ague). These two diseases are types of this class. 2. The *Enthetic* diseases, which may properly be called *contagious*, being communicated by contact, puncture, or inoculation. Syphilis and glanders are types of this class. 3. The

Dietic diseases, which arise when the blood is supplied with improper or bad food. Scurvy and ergotism are the types of this class. 4. The *Parasitic* diseases, which attack especially dirty populations, and infest the skin, the intestinal canal, and all the structures of the body.

This classification, which does not now hold good, is quoted here because it continues to be spoken of. Modern pathology has necessitated its revision.

Recently, indeed, the word 'zymotic' has been restricted to the acute specific diseases, included under the first group (miasmatic) in the above classification; and at the present time it is in this limited sense that it is most commonly used.

Corresponding with the adjective *zymotic* is the substantive *zyme*. This is a useful name, by which we refer to the poisonous cause of zymotic diseases. It is simpler than the word *zymine*, originally proposed by Dr. Farr; and (what is much more important) to speak of the contagious poison as 'a zyme' does not imply the acceptance of any particular theory of disease; while, on the other hand, the use of the word 'germ' distinctly conveys the idea of some organised structure, itself the cause of the disease by subsequent growth and multiplication. *See* CONTAGION; GERMS OF DISEASE; and MICRO-ORGANISMS.

The necessity for employing the word *zymosis* does not seem to be felt as yet; but the same reasons that lead us to speak of the agent as a zyme should also guide us to use *zymosis* in place of the more usual periphrases. VICTOR HORSLEY.

THE END

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